A Preliminary Study of the Males of Some Hawaiian Mealybugs (Homoptera: Pseudococcidae)

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(*Submitted for publication December, 1959*)

INTRODUCTION

The systematics of the Coccoidea is based almost entirely upon characters of the adult females, and only a few attempts have thus far been made to utilize those of the male sex. Morrison (1928) made considerable use of males in his classic treatment of the Margarodidae, and Borchsenius (1957) described and figured available males of Russian Coccidae. Recently, Bustshik (1958) has provided figures and descriptions of the males of Russian species of Diaspididae, as well as keys to genera and species based on the males. With the exceptions of these papers, treatment of male scale insects has been confined largely to morphological studies and an occasional description of an individual species.

Among the more important papers dealing with male mealybugs are those of Mäkel (1942) and Jancke (1955). The former is a detailed morphological study of the skeletal and muscular systems based on males of three species. The latter is a study of the comparative morphology of the males of the various groups of Coccoidea, and includes descriptions of males of two species in different genera (*Phenacoccus* and *Planococcus*) of the Pseudococcidae. Recently, a thorough study in comparative external morphology of male scales has been presented by Theron (1958). He included one pseudococcid, *Planococcus citri* (Risso), among the seven species which he treated. Although fairly detailed descriptions of the males of a few species of mealybugs are available (Cottier, 1936; Morrison, 1945; Uichanco & Villanueva, 1932), no attempt has as yet been made to delineate characters which might be of value in separating and identifying genera and species of mealybug males.

The neglect of the male sex in the mealybugs and in other coccids has, no doubt, been due at least partially to the difficulties involved in securing adequate material for study. Although biological studies (James, 1937a) indicate that, in certain species at least, the sex ratio of mealybug progeny may be about 1:1, adult males are very short-lived and fragile so that, unless special effort is made to secure them, they are usually unrepresented in material collected and preserved in the field. Some species of mealybugs appear to be entirely parthenogenetic, no males being known. For example, I have obtained colonies of *Dysmicoccus brevipes* (Cockerell) from several hosts on Oahu, and no males were ever recovered.

Also, there is evidence that *Phenacoccus solani* Ferris may be entirely parthenogenetic (Lloyd, 1952). Males of the known Hawaiian representatives of the genera *Antonina*, *Geococcus*, and *Ripersiella* are unknown to me, but only limited amounts of living material of these have been examined.

Acknowledgments

This work was carried out under the direction of Dr. D. E. Hardy, University of Hawaii, Agricultural Experiment Station, to whom I am indebted for advice and suggestions. I am also much in debt to Dr. L. D. Tuthill, Department of Zoology and Entomology, University of Hawaii, for additional suggestions and for critical reading and editing of the manuscript.

Materials and Methods

Whenever possible living material was utilized for preparation of slide mounts for study. Mealybug colonies collected in the field were held in the laboratory for several days so that freshly emerged males could be secured. In some cases it was necessary to hold material for as long as 10 or 12 days after collecting until the first males appeared. Specimens of males and associated females usually were prepared together by the method normally used in the preparation of mounts of the female mealybugs alone. It was found that satisfactory clearing could be obtained by soaking specimens for 12 to 48 hours at room temperature in 10 per cent KOH solution, and subsequently heating (but not boiling) in this solution for about 20 minutes. Male mealybugs usually cleared well without the manipulation which is frequently necessary in order to remove the body contents of the females. Staining was accomplished in an aqueous solution of basic fuchsin, and specimens were allowed to remain in the dye for 24 to 48 hours to secure the desired degree of staining. It was found that strongly stained specimens were most satisfactory for the study of such morphological features as the weakly sclerotized areas of the abdomen and the dermal discs. Males were usually mounted on slides with associated females. Fragments of #1 cover slips were used about the margins of the balsam drop on some slides to prevent crushing and distortion of the head and thorax, although once these structures had been studied on a few uncrushed specimens it was not considered necessary to handle additional material this way.

Both dorsal and ventral mounts were made whenever sufficient material was available in order to secure adequate mounts for study of the structural details of the more important morphological features, such as the shape of the penial sheath. It was found considerably more difficult to secure satisfactory mount of males than of females. For this reason ten or more male specimens of each species were mounted whenever material was adequate.

The Male of Pseudococcus adonidum (L.)

A relatively detailed description of the male of *Pseudococcus adonidum* (L.) is given here in order to consider the salient morphological features which are normally seen in slide mounted specimens of male mealybugs prepared by the method described above. The descriptions of the males of other forms which follow are limited to those characters which were found useful in separating the species studied. *Pseudococcus adonidum* was selected for detailed treatment because that species is generally accepted as the type of the genus *Pseudococcus* (see Ferris, 1950, pp. 170–171). Also, it is a common and widely distributed form. The females associated with the males upon which this description is based agree well with Ferris' (1948, 1950) concept of *P. adonidum*. The terminology employed for the various sclerites considered is adapted largely from Theron (1958), and the reader is referred to his paper and that of Mäkel (1942) for more detailed treatments of the exoskeleton and musculature of mealybug males.

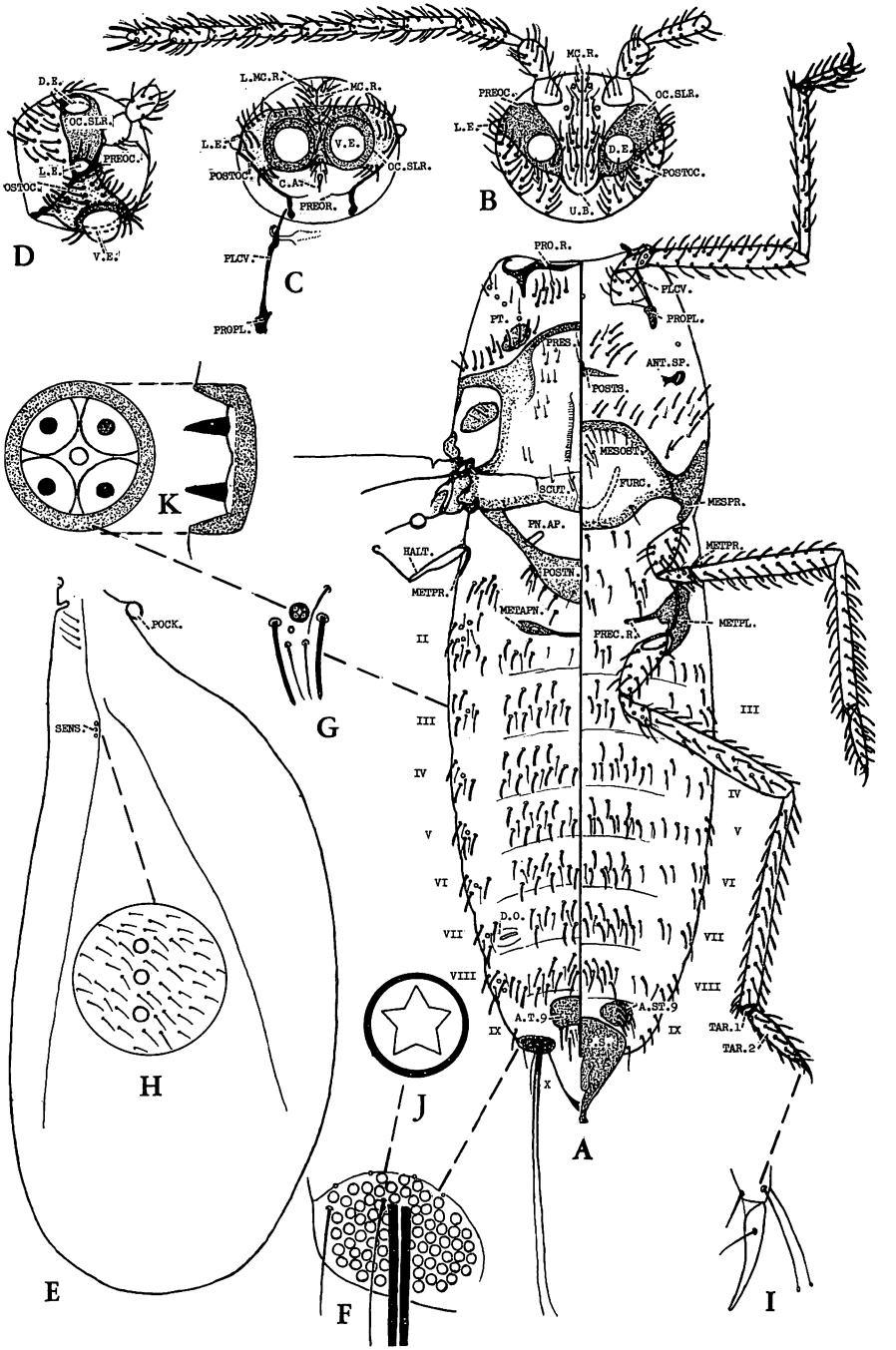
Head: According to both Mäkel and Theron the imaginal head consists mostly of epicranium, those portions of the head associated with the mouthparts in other groups having largely degenerated. Functional mouthparts are entirely lacking, and the mouth is represented by a barely discernible circular opening near the posterior margin of the venter of the head. Anterior to the mouth there is sometimes discernible a midventral longitudinal fold, termed the cranial apophysis by Theron (fig. 1, C, c.a). The head bears three pairs of conspicuous simple eyes; one pair ventrally, one pair laterally, and one pair dorsally. The three eyes of each side of the head are enclosed within a single sclerotized plate, termed the ocular sclerite by Theron (fig. 1, B,C,D, oc.slr.), and the two plates are broadly fused at their juncture between the ventral eyes. In *P. adonidum* the part of each ocular sclerite around the ventral eye, and the area extending dorsad from the lateral eye and enclosing the dorsal eye, are noticeably more heavily sclerotized than the intervening area. In some other species the ocular sclerites are more uniformly developed. A thickened ridge or band, the postocular ridge of Theron, (fig. 1, B,C,D, postoc.), extends along the posterior margin of each ocular sclerite from just behind the dorsal eye to the region behind the ventral eye, where its posteriorly directed apex forms an articulation with the cervical sclerite. A weak, mesally directed extension of each postocular ridge, behind the ventral eye, is termed the preoral ridge by Theron (fig. 1, C, preor.). A thickened preocular ridge (fig. 1, B,D, preoc.) arises from each postocular ridge at the posterio-ventral corner of each lateral eye, and extends dorsally along the anterior margin of each ocular sclerite. In *P. adonidum*, the dorsal lobes of the two ocular sclerites appear to be united by a weak, sometimes interrupted, U-shaped band (fig. 1, B, u.b.) which extends around the posterior end of a well-defined midcranial ridge or suture (fig. 1, B, mc.r.). Although it is figured by Mäkel, Theron did not find this band complete in *Planococcus citri* males, and he figures instead a pair of arcuate "meniscate bands" which mark

the posterior margin of an elongate dorsomedial sclerite. Although this dorsomedial sclerite is present in my preparations of *P. citri*, it is not discernible in specimens of *P. adonidum*. In the other species studied this sclerite showed varying degrees of development, often being represented by an area of weak sclerotization on each side of a well-developed midcranial ridge. The midcranial ridge in *P. adonidum* extends from near the center of the dorsal U-shaped band down the front of the face between the antennae where it terminates slightly below the level of the antennal condyles, between the diverging arms of a shallowly Y-shaped band. The stem of this Y-shaped band is formed by a prominent medio-ventral suture which extends upward as a continuation of the ventral line of juncture of the two ocular sclerites. Theron considers this ventral band (fig. 1, C, mc.r.) to be a separated part of the midcranial suture, and the lateral arms of the "Y" (fig. 1, C, l.mc.r) as lateral branches of that suture.

The ventral eyes are the largest and are set close together near the mid-ventral juncture of the ocular plates (fig. 1, C, v.e.). The margins of the sockets of these eyes appear as conspicuous, flat, circular rims. The sockets measure about 46 μ at their greatest diameter. The dorsal eyes (fig. 1, B, d.e.) are slightly smaller and are set farther apart than are the ventral eyes. Their sockets are about 36 μ maximum diameter, and the margins of the sockets are narrower than those of the ventral eyes. The lateral eyes (fig. 1, B,C,D, l.e.) are the smallest, and protrude strongly from the sides of the head. The sockets of these eyes are not perfectly circular, but appear more nearly triangular in outline. The margins of the sockets are formed by strongly sclerotized bands, including portions of the preocular and postocular ridges which are confluent at the posterio-ventral angle of these eyes. According to Theron, the lateral eyes are persistent larval ocelli, and the dorsal and ventral eyes are vestiges of the compound eyes found in the adults of other Homoptera (see Theron, 1958, pp. 19–20). In living specimens the eyes are dark red in color, the lateral pair appearing a trifle darker than the others. The large ventral pair protrude below as conspicuous hemispheres, and, when the head is viewed from the side, these appear to be directed forward at a slight angle from the perpendicular.

The antennae (fig. 1, B.) are ten-segmented, flagellate, and are about 0.7 mm. over-all length. Each scape appears to articulate at a small projection on the preocular ridge between the dorsal and lateral eyes, but nearer the latter. The scapes are relatively short and thick (39 μ long by 42 μ maximum width at base) as in the female. The pedicels are longer, but are noticeably thicker than the flagellar segments (about 60 μ long by 36 μ maximum width). Segments 3 to 10 measure about 100:75:75:75:63:63:57:66 μ long respectively, and are all about

FIGURE 1. Male of *Pseudococcus adonidum* (L.). A, dorsal and ventral aspects of thorax and abdomen; B, dorsal aspect of head; C, ventral aspect of head; D, lateral aspect of head; E, forewing; F, tail-forming pore cluster of 9th abdominal segment; G, dermal disc and associated setae of abdomen; H, detail of microtrichia and circular sensoria on upper surface of wing; I, detail of claw of hind tarsus; J, detail of stellate pore of tail-forming cluster; K, details of dermal disc.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the same width (about 25 μ maximum). In addition to the two types of setae present on other parts of the body, the antennae bear a few noticeably longer (about 57 μ maximum length) and thicker setae on the three apical segments, usually one each on segments 8 and 9, 2 or 3 on segment 10 (fig. 1, B). These may serve some special sensory function. Similar setae are present on the apical segments of the antennae in all the species studied, and these have been termed "specialized sensory hairs" in the descriptions which follow.

Thorax: Dorsally the anterior margin of the prothorax is marked by a pair of well-defined bar-like transverse sclerites which meet, or nearly so, at the midline, but are not fused. Mäkel believed these sclerites to be cervical in origin, but Theron has interpreted these as belonging to the true prothorax, and has termed them pronotal ridges (fig. 1, A. pro.r.). Lateral arms of these sclerites extend ventrad on each side of the prothorax, the apex of each arm nearly touching the anterior portion of a long, bar-like, longitudinal sclerite which extends from each propleuron. A short, caudally directed bar extends perpendicularly from the lateral arm of each pronotal ridge about half way down the side. The long anterior extension of each propleuron (fig. 1, A,C, plcv.) in considered by Theron to be composed basally of part of the true propleuron, which is fused apically to the true cervical sclerite. The apex of each of these sclerites appears to articulate with the posterior end of the postocular ridge.

The remainder of the dorsum of the prothorax is largely unsclerotized, except for a pair of relatively weakly staining posterior patches (fig. 1, A, pt.) one on each side of the forward projecting anterior median hump of the mesothoracic prescutum. Theron considers these to be vestigial post-tergites. The prothoracic pleurites are each reduced to a small remnant which bears the fore-coxal articulation, and the long, bar-like, anterior extension. A narrow transverse sclerite, which projects roundly forward at its center, is located at about the posterior margin of the venter of the prothorax, and is considered by Theron to be the remnant of the prothoracic poststernum (fig. 1, A, posts.).

The wing-bearing mesothorax is well developed and strongly sclerotized. For detailed discussion of the comparative anatomy and morphology of this segment see Theron's (1958) description of *Planococcus citri.* The mesothoracic prescutum (fig. 1, A, pres.) is strongly humped anteriorly. The postnotum (fig. 1, A, postn.) is conspicuously developed and is separated from the scutellum (fig. 1, A, scut.) by a rather large membranous area. A pair of conspicuous postnotal apophyses extend ventrally inward from the lateral margins of the postnotum (fig. 1, A, pn.ap.). The mesosternum (fig. 1, A, mesost.) is well developed and bears a conspicuous furca (fig. 1, A, furc.) which extends internally from its posterior margin. The mesopleurites are strongly developed beneath the wings and are narrowly joined to the sides of the mesosternum below. Each mesopleurite bears a small posteriorly-directed projection (part of the thickened mesopleural ridge according to Theron) on its hind margin, which articulates with the mesocoxa (fig. 1, A, mespr.).

The metapleurites (fig. 1, A, metpl.) are present but relatively small. A well-developed metapleural ridge extends dorsally from the base of each metacoxa as a long, bar-like sclerite which reaches to the base of the halter (fig. 1, A, metpr.). There is also a slender ventral transverse extension from each metapleurite, termed the precoxal ridge by Theron (fig. 1, A, prec.r.) which reaches about half way to the mid-ventral line. There is no discernible sclerotized metasternum. The narrow transverse dorsal sclerite behind the mesopostnotum is termed the metapostnotum (fig. 1, A, metapn.) by Theron.

The legs (fig. 1, A.) are well-developed, elongate, and slender. The hind femora measure about 200 μ long by about 42 μ maximum width. The tarsi are two-segmented in *P. adonidum* and in males of all other species studied. The basal segment (fig. 1, A, tar. 1) is very small, being little more than a narrow ring, wider along its posterior face. The trochanters each bear five circular sensoria. The tarsal claws (fig. 1, I) are noticeably longer and more slender than those of the female; those of the hind tarsi measuring about 36 μ long by about 9 μ wide at the base. The digitules of the tarsal claws are short, slender, and setiform; not spatulate apically as are those of the female. The apex of the distal tarsal segment bears two slender, apically spatulate setae as in the female.

The fore-wings are well-developed in all specimens of *P. adonidum* seen. These possess two discernible longitudinal veins which are usually designated as the radius and the media. Both surfaces of the wings are densely covered with microtrichia (fig. 1, H) about 4 or 5 μ in length. A compact row of 3 or 4 circular sensoria (fig. 1, E, sens.) is located on the dorsal surface along the anterior (radius) vein just above and distad of the basal end of the posterior vein. A transverse row of 3 or 4 slender setae (fig. 1, E) each about 25 μ long, is situated on the leading edge of the anterior vein near its base.

The hind wings are reduced to a pair of halteres (fig. 1, A, halt.). These are finger-like, about 90 μ long, and each bears at its apex a single slender seta about 60 μ long, the end of which is recurved to form a conspicuous hook. A circular pocket on the posterior margin of each fore-wing (fig. 1, E, pock.) serves as a receptacle for the hook of the halter.

The two pairs of thoracic spiracles found in females are present and of similar form in the males. (Actually, these are each a spiracle plus an associated peritreme, according to Theron). The anterior (mesothoracic) pair (fig. 1, A, ant. sp.) is situated laterally below the fore end of the prescutum of the mesothorax, and slightly behind but in nearly the same horizontal plane as is the articulation of the fore coxa with the propleuron. The posterior spiracle is located almost directly ventrad of the base of the halter and about in the same horizontal plane as the articulation of the mesocoxa.

Abdomen: The abdomen consists of nine discernible segments, which appear to be homologous with the nine visible segments of the female abdomen. In the female, Ferris (1950) considers these to represent segments 2 to 9, with segment 10 reduced to a small area between the anal lobes ventrally, and to the mem-

branous area surrounding the anal ring dorsally. According to Ferris' interpretation, the posterior dorsal ostioles of the female lie in the morphological seventh abdominal segment. A pair of faint dorsal ostioles (fig. 1, A, d.o.) are present on the abdomen of males of *P. adonidum*, and in males of some other species, (e.g.: *Laminicoccus giffardi* (Ehrhorn)) these are more noticeably developed. If the posterior dorsal ostioles of the male also are assumed to lie in the seventh abdominal segment, it then appears that the second abdominal segment is the first discernible one, as in the female. By this interpretation, the tenth segment of the male abdomen is represented by the largely unsclerotized triangular area of the dorsum immediately over the ventral penial sheath. Theron considers that in *P. citri* this area consists of the fused ninth and tenth abdominal tergites, and he considers the pore clusters and associated long hairs whcih give rise to the caudal wax tails of the male to lie near the posterior margin of abdomianl segment 8. However, as I have interpreted abdominal segmentation, these structures are located on the posterior margin of segment 9 in *P. adonidum*, and in all other species studied (excepting *Phenococcus gossypii* Townsend & Cockerell, which possesses wax tails on segment 8 as well as segment 9).

Except for the strongly sclerotized apical penial sheath (fig. 1, A, p.s.) The abdomen is largely unsclerotized. The ventrite of the ninth abdominal segment bears a small weakly sclerotized patch on either side (fig. 1, A, a.st. 9) and the ninth tergite bears a relatively large rectangular area of similar development (fig. 1, A, a.t. 9). There is also a small weakly sclerotized patch on the middle of the dorsum of the tenth abdominal segment above the penial sheath.

The penial sheath (fig. 1, A, p.s.; fig. 2, A,B) is considered to be an apical process of the ninth abdominal segment (see Tuxen et al, 1956; pp. 152–153, fig. 191). It is heavily sclerotized, roughly triangular in outline, and measures about 155 μ long by about 140 μ maximum width. It consists of a broad ventral plate which tapers posteriorly to a narrow apical extension (fig. 2, A, ext.). The tip of the apical extension is slightly expanded, truncate, and is about 21 μ maximum width. In lateral view the tip appears to be bent upward slightly. A conspicuous longitudinal slit, which begins about half way from the base of the sheath, extends nearly to the tip of the apical extension (fig. 2, A, sl.). In many preparations the apical portion of the penis may be seen extending through this slit. A pair of finger-like median lobes, each about 36 μ long (fig. 2, A, m.l.), arise, one on each side, near the base of the median slit. From the side (fig. 2, B) these lobes appear to be directed downward at a slight angle so that the tips are somewhat below the level of the bases. The tips of the median lobes are rounded and bear several small, fine setae. The sclerotized portion of the actual penis is an elongate slender rod, the apical portion of which forms a very shallow sigmoid curve so that the tip is directed in a postero-ventral direction (fig. 2, C). According to Theron, the sclerotized portion of the penis of *P. citri* lies along the ventral margin of that organ. At its base the penis appears to be attached internally to the basal part of the ventral sheath by a broad longitudinal apodeme (fig. 2, C,

apd.) which, according to Theron, actually is the modified ventral lip of the internal genital aperture. Spermatozoa are visible within the abdomen in many male mealybug, and the structure of heads can sometimes be determined with an oil emersion objective (see Doutt, 1952).

Dermal structures: A conspicuous group of circular pores and long hairs is present on the postero-lateral margin of each side of the ninth abdominal segment. (fig. 1, A, F). These structures give rise to the prominent caudal wax tails of the living adult male mealybug. In *P. adonidum* there are two very long hairs, about 400 μ in length, a slender seta about 100 μ long, and a smaller seta about 40 μ long associated with the tail-forming pores on each side of the ninth segment. Each pore cluster contains about 60 or 70 individual pores of a type not found in the female. These pores (fig. 1, J) are circular in outline, about 6 or 7 μ in diameter, with a narrow outside rim and a five-pointed star-shaped lumen. The lumen appears to be septate internally, but the septa are too fine to determine accurately with the available magnification. These pores will subsequently be referred to as stellate pores. There are no trilocular pores, multilocular disc pores, or large tubular ducts (such as occur on the derm of the females) present in the adult males of this or any of the other species studied, although some of these structures occur in the immature stages of *P. adonidum* males (see James, 1937b). A few minute structures which appear to be extremely small, short, tubular ducts elevated on small papillae were found in the vicinity of some of the prominent dermal disc structures of the abdomen. These ducts measured about 2.5 μ in diameter and 2.5 μ in depth.

The peculiar dermal disc structures referred to above (fig. 1, K) also appear to be confined to the male sex. In *P. adonidum* these discs are found along the lateral margins of the dorsum of the abdominal segments, on the prothorax, and on the head. They are usually circular or somewhat quadrilateral in outline, and each consists of an outer rim within which are four (occasionally three or five) roughly circular peripheral loculi. In lateral view these discs appear as recessed dish-like structures. A short, stout, peg-like projection about 3 μ long, extends upward from the center of each of the peripheral loculi. A diamond-shaped loculus, within which a small central circular septum is at times discernible, occupies the central area of the disc between the peripheral loculi. The discs measure about 7 or 8 μ in outside diameter in *P. adonidum*. Whether these discs are sensory or secretory in function, or both, was not determined. Similar structures were found in males of all other species studied, although these sometimes differed in the number of peripheral loculi present, and often were noticeably smaller than those of *P. adonidum*. A few, very small, simple, circular pores, about 3 μ in diameter, are present on the dorsum at the margins of the clusters of stellate pores and along the lateral margins of the anterior abdominal segment in the vicinity of the dermal discs (fig. 1, G).

Both dorsum and venter are clothed with conspicuous setae which are of two distinct types, a relatively thick, finger-like form (digitiform setae) which are

not found on the female, and the usual type of slender filamentous setae. Of these, the digitiform type is more numerous. These are about 26 to 30 μ long and of nearly uniform thickness throughout, with an acute tip (fig. 1, G). These setae are not found on the heavily sclerotized parts of the mesothorax or the penial sheath. The less numerous slender setae vary in length from about 15 to 30 μ (fig. 1, G). The setae of the head, antennae, and legs are of both types with the digitiform predominating. Digitiform setae of the antennae and legs are a trifle longer than those of the body, reaching about 36 μ maximum length.

Comparison of Males of Thirty Species Found in Hawaii

Males of 30 described species, including representatives of 13 described genera were obtained for study. The bulk of the specimens studied were obtained either from fresh field-collected and laboratory-reared material, or from dried *in situ* material in the collection of the Experiment Station, HSPA. Males of one peculiar endemic form, *Phylococcus oahuensis* (Ehrhorn), were obtained from leaf galls on specimens of the host plant housed in the herbarium of the Bernice P. Bishop Museum.

With the exception of two closely related species of *Pedronia*, it was possible to separate the species studied satisfactorily on the basis of characters present in the male sex. The structure found most useful in separating the males was the apical penial sheath. The penial sheaths of nearly all the species considered have been illustrated in figures 2 and 3. The shape of the ventral sclerotized portion of the penis may also prove to be of taxonomic value. However, as this structure was frequently obscured by the heavily sclerotized penial sheath in my preparations, no attempt has been made to utilize it here. Body size, lengths of appendages, and the diameters of the dorsal and ventral eyes were all found to be of some value in separating species. The distribution of patches of weak sclerotization on the abdominal segments was also sometimes useful, but it was necessary that the specimens be very well stained for the proper detection of these areas. The form, size, number and distribution of small dermal structures (pores, dermal discs, and setae) were also utilized, but the amount of interspecific variation exhibited by such structures was found to be much less marked in the male sex than in the females.

Fully winged males were found in every species studied. However, in one species, *Saccharicoccus sacchari* (Cockerell), completely apterous males were also encountered, and in another species, *Palmicola palmarum* (Ehrhorn), brachypterous males with reduced, non-funcitonal wings occurred together with ma-

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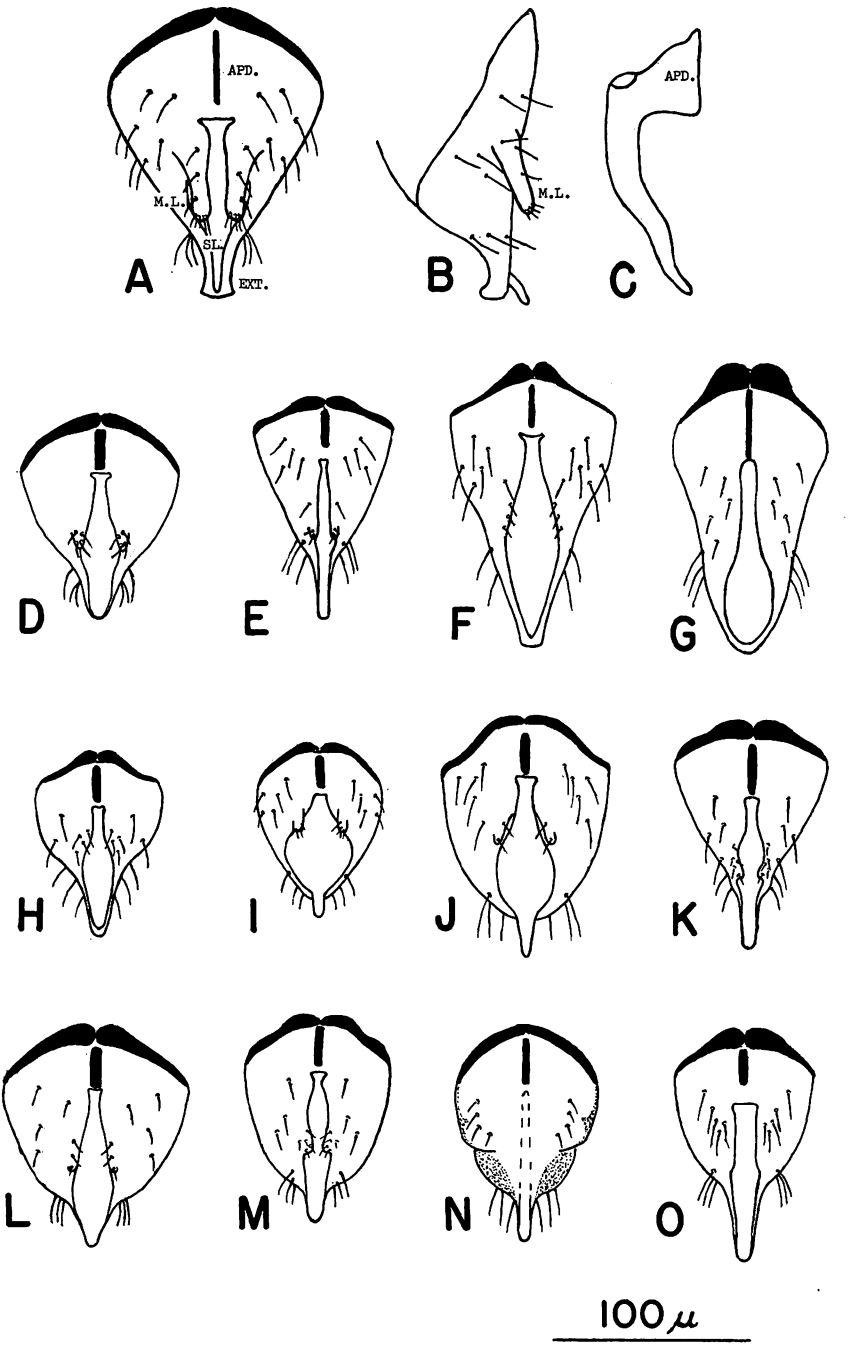
Figure 2. A, ventral aspect of penial sheath of *Pseudococcus adonidum*; B, lateral view of same; C, lateral aspect of penis of *P. adonidum*. Ventral aspects of penial sheaths of: D, *Clavicoccus tribulus;* E, *Dysmicoccus boninsis;* F, *D. neobrevipes;* G, *Ferrisiana virgata;* H, *Nesococcus pipturi;* I, *Nipaecoccus nipae*; J, *N. vastator;* K, *Pedronia acanthocauda;* L, *P. cibotii;* M, *P. hawaiiensis;* N, *Phenacoccus gossypii; O, Phylococcus oahuensis.*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cropterous males. In these two species males lacking functional wings were found to possess fewer antennal segments than their macropterous counterparts. Generally, the number of antennal segments was of little taxonomic value as only rarely were there fewer than the basic number of 10 segments. In no case were more than 10 segments found.

With the exception of *Phenacoccus gossypii* Townsend and Cockerell, all of the species studied were found to possess but a single pair of caudal wax tails. In *P. gossypii* wax tails are present on both abdominal segments 8 and 9. Jancke (1955) shows two pairs of tail-forming setae and associated pores in his figure of the male of *Phenacoccus piceae* Low, and Green's (1922) figure of the male of his *P. insolitus* also has two pairs of tails. The male of *Heterococcus graminicola* Morrison (Morrison, 1945) is described as possessing two pairs of tail-forming "cerarii". It is possible that two pairs of caudal wax tails may be of general occurrence in males of *Phenacoccus* and related genera.

The key to species and the descriptions which follow are offered somewhat hesitantly as the treatments of several of those considered are based on rather inadequate material. In several species where adequate series of specimens were studied, a certain amount of intraspecific variation was encountered in such characters as appendage lengths, the number and distribution of dermal discs, and the size and development of sclerotized areas. In view of this variability, the measurements given in the descriptions should not be interpreted as defining exact limits. Such measurements are presented because they were found to be of considerable value in comparing species, particularly where interspecific differences were relatively large. It is possible that it will become necessary to modify the present key when additional material of the more poorly represented species is examined.

The males of the species which have been considered in this study appear to offer less in the way of interspecific differences than is to be found in females of these species. Differences which might be deemed of generic significance are less apparent in the male sex than in the females, and without exception those characters which have been utilized to define genera in the female sex are absent or greatly altered in the male sex. When the males have been adequately studied, it is possible that they will prove to be of value in elucidating phylogenetic relationships and, perhaps, in bringing to light cases of convergence in the females. For these reasons it seems wise to encourage the collection and preservation of male mealybug specimens whenever these can be found in definite association with females.

KEY TO THE KNOWN MALES OF HAWAIIAN MEALYBUGS

1. Abdomen with two pairs of tail-forming pore clusters and associated long hairs, one pair each on segments 8 and 9 ..... **Phenacoccus gossypii** Townsend & Cockerell

   Abdomen with a single pair of tail-forming pore clusters and associated long hairs on segment 9 2

2. Apex of penial sheath broadly truncate or nearly so, usually expanded slightly at tip; median lobes of sheath conspicuously developed 3

   Apex of penial sheath usually rounded or pointed, if truncate then with median lobes very much reduced or absent 7

3. Apex of sheath relatively narrow, about 10 μ wide at expanded part of tip; antennae relatively short, about 425 μ long; abdomen with slender filamentous setae only ..... **Pseudococcus floriger** Ferris

   Apex of sheath wider, 20 μ or more wide at expanded part of tip; antennae relatively long, 600 μ or longer; abdomen with both digitiform and slender filamentous setae 4

4. Apex of penial sheath relatively very wide, about 35 or 36 μ across expanded portion ..... **Pseudococcus dorsispinosus** Beardsley

   Apex of penial sheath narrower, less than 30 μ across expanded portion 5

5. Apex of penial sheath about 21 μ wide across expanded portion; digitiform setae relatively numerous on dorsum of abdomen, more plentiful than slender filamentous setae ..... **Pseudococcus adonidum** (L.)

   Apex of penial sheath wider, 24 μ or more across expanded portion; digitiform setae of dorsum of abdomen relatively sparse, less numerous than slender filamentous setae 6

6. Apex of penial sheath about 24 or 25 μ wide across expanded portion; eyes smaller, dorsal pair each about 32 μ in diameter, ventral pair each about 36 μ in diameter ..... **Pseudococcus lycopodii** Beardsley

   Apex of penial sheath about 27 or 28 μ wide across expanded portion; eyes larger, dorsal pair each about 39 μ in diameter, ventral pair each about 42 μ in diameter ..... **Pseudococcus antricolens** Ferris

7. Apex of penial sheath relatively broadly rounded, width at 9 μ before tip 22 μ or more 8

   Apex of penial sheath relatively finely pointed or somewhat truncate, width at 9 μ before tip 16 μ or less 11

8. Digitiform setae of legs and abdomen very long, those of hind femora about 60 μ in length; dermal discs of abdomen all with 3 peripheral loculi, appearing triangular in outline ..... **Ferrisiana virgata** (Cockerell)

   Digitiform setae of appendages shorter, those of hind femora about 30 μ or less in length, most dermal discs with 4 peripheral loculi, occasionally with 3 or 5 9

9. Penal sheath relatively short, about 135 μ over-all length (fig. 3, I) ..... **Pseudococcus montanus** Ehrhorn

Penial sheath longer, 170 μ or more over-all length 10

10. Penial sheath very long, about 200 μ over-all length, apical portion evenly tapered, not swollen before tip (fig. 3, C); dorsum of anterior abdominal segments without discernible sclerotized patches ..... **Pseudococcus citriculus** Green

Penial sheath shorter, about 175 μ over-all length, apical portion slightly expanded before tip (fig. 3, H); dorsum of anterior abdominal segments with small paired patches of weak sclerotization ..... **Pseudococcus maritimus** (Ehrhorn)

11. Dermal discs of abdomen with from 5 to 7 peripheral loculi 12

Dermal discs of abdomen mostly with 4 peripheral loculi, occasionally with 3 or 5, discs sometimes apparently lacking in one species 13

12. Antennae very long, nearly 1 mm. total length; eyes very large, dorsal and ventral both about 60 μ diameter... **Nipaecoccus vastator** (Maskell)

Antennae shorter, about 0.5 to 0.6 mm. total length, eyes smaller, dorsal about 30 μ diameter, ventral about 33 μ diameter ..... **Nipaecoccus nipae** (Maskell)

13. Digitiform setae of abdomen relatively plentiful, usually more numerous on venter than on dorsum 14

Digitiform setae absent on abdomen, or, if present, not more than about 10 discernible 17

14. Apical portion of penial sheath forming a relatively fine slender point, 6 to 8 μ wide at 9 μ before tip 15

Apical portion of penial sheath wider, 12 to 16 μ wide at 9 μ before tip... 16

15. Antennae 8- or 9-segmented, very short (not more than about 0.35 mm. total length); dorsal digitiform setae of abdomen short, 12 to 14 μ in length; both macropterous and brachypterous forms known ..... **Palmicola palmarum** (Ehrhorn)

Antennae 10-segmented, longer (about 0.6 to 0.65 mm. total length); dorsal digitiform setae of abdomen longer, mostly 24 to 30 μ in length; macropterous form only known..... **Dysmicoccus boninsis** (Kuwana)

16. Penial sheath relatively long, about 145 μ over-all length, median lobes apparently lacking (fig. 2, F)..... **Dysmicoccus neobrevipes** Beardsley

Penial sheath shorter, about 100 μ over-all length, median lobes represented by a pair of small humps (fig. 2, D)... **Clavicoccus tribulus** Ferris

17. Completely apterous, without vestiges of wings; sclerites of thorax not developed..... apterous form of **Saccharicoccus sacchari** (Cockerell)

Macropterous; thorax developed normally 18

18. Digitiform setae of antennae relatively short, maximum length 18 μ or less 19

Digitiform setae of antennae longer, maximum length 25 μ or more....21

19. Penial sheath about 140 μ over-all length, apex about 14 μ wide at 9 μ before tip, without discernible median lobes (fig. 3, F)..... .....**Laminicoccus giffardi** (Ehrhorn)

Penial sheath about 110 μ or less over-all length, apex 10 μ or less in width at 9 μ before tip, a small pair of median lobes present.....20

20. Digitiform setae of antennae very short, 10 μ or less in length; legs and antennae relatively short (antennae about 0.43 mm. long, hind femora about 115 μ long.....**Trionymus rostellum** Lobdell

Digitiform setae of antennae longer, 15 to 18 μ in length; legs and antennae longer (antennae about 0.55 mm. or more long, hind femora about 150 μ long).....**Trionymus lounsburyi** Brain

21. Posterior portion of penial sheath moderately elongate, apex slightly expanded before tip, tip rounded, margins of ventral slit becoming abruptly transverse so as to form approximately right angles at about half way between base and apex (fig. 3, L.); dermal discs present on midventral areas of several abdominal segments..... .....alate form of **Saccharicoccus sacchari** (Cockerell)

Penial sheath not so formed; dermal discs of abdomen confined to lateral margins of segments 22

22. Venter of abdomen with large median sclerotized patches on segments 5 to 9, and similar less strongly sclerotized patches on segments 2 to 4; dorsum of abdomen with similar patches on segments 7 to 9 and sometimes 6.....**Pedronia acanthocauda** Beardsley

Without such sclerotized patches, patches of abdomen when present smaller, less strongly developed, and involving fewer segments.....23

23. Apex of penial sheath in form of a fine slender point about 6 or 7 μ wide at 9 μ before tip, sheath without discernible median lobes (fig. 3, K); dermal discs of abdomen reduced to not more than 2 or 3 on each side, sometimes apparently absent; digitiform setae wanting on abdomen, slender setae of venter of abdomen very long, nearly 50 μ maximum length.....**Pseudococcus straussiae** Ehrhorn

Without the above combination of characters.....24

24. Apical portion of penial sheath relatively elongate, about one-half as long as the basal portion (fig. 2, O)..**Phylococcus oahuensis** (Ehrhorn)

Apical portion of penial sheath less noticeably elongate.....25

25. Penial sheath without discernible median lobes.....26

Penial sheath with a pair of small median lobes or rounded protuberances..28

26. Penial sheath relatively long, about 145 μ over-all length (fig. 3, N).... .....**Trionymus multiductus** Beardsley

Penial sheath shorter, 120 μ or less over-all length.....27

27. Claws of hind tarsi about 45 μ long; digitiform setae present on abdomen ..... **Nesococcus pipturi** Ehrhorn

    Claws of hind tarsi shorter, about 28 μ long; abdomen without digitiform setae ..... **Trionymus refertus** Ferris

28. Claws of hind tarsi about 40 μ long; dermal discs of abdomen relatively numerous, usually 3 or 4 per segment on each side; abdomen without digitiform setae ..... **Planococcus citri** (Risso)

    Claws of hind tarsi shorter, about 30 μ long or less; dermal discs of abdomen less numerous, not more than 1 or 2 per segment on each side; a few digitiform setae usually present on venter of abdomen 29

29. Antennae relatively short, total length about 0.45 mm., 3rd segment about 50 μ long ..... **Pedronia crypta** Beardsley

    Antennae longer, 0.54 to 0.6 mm. total length, 3rd segment about 75 μ or more long ..... **Pedronia cibotii** Beardsley and **Pedronia hawaiiensis** Ferris

Clavicoccus tribulus Ferris

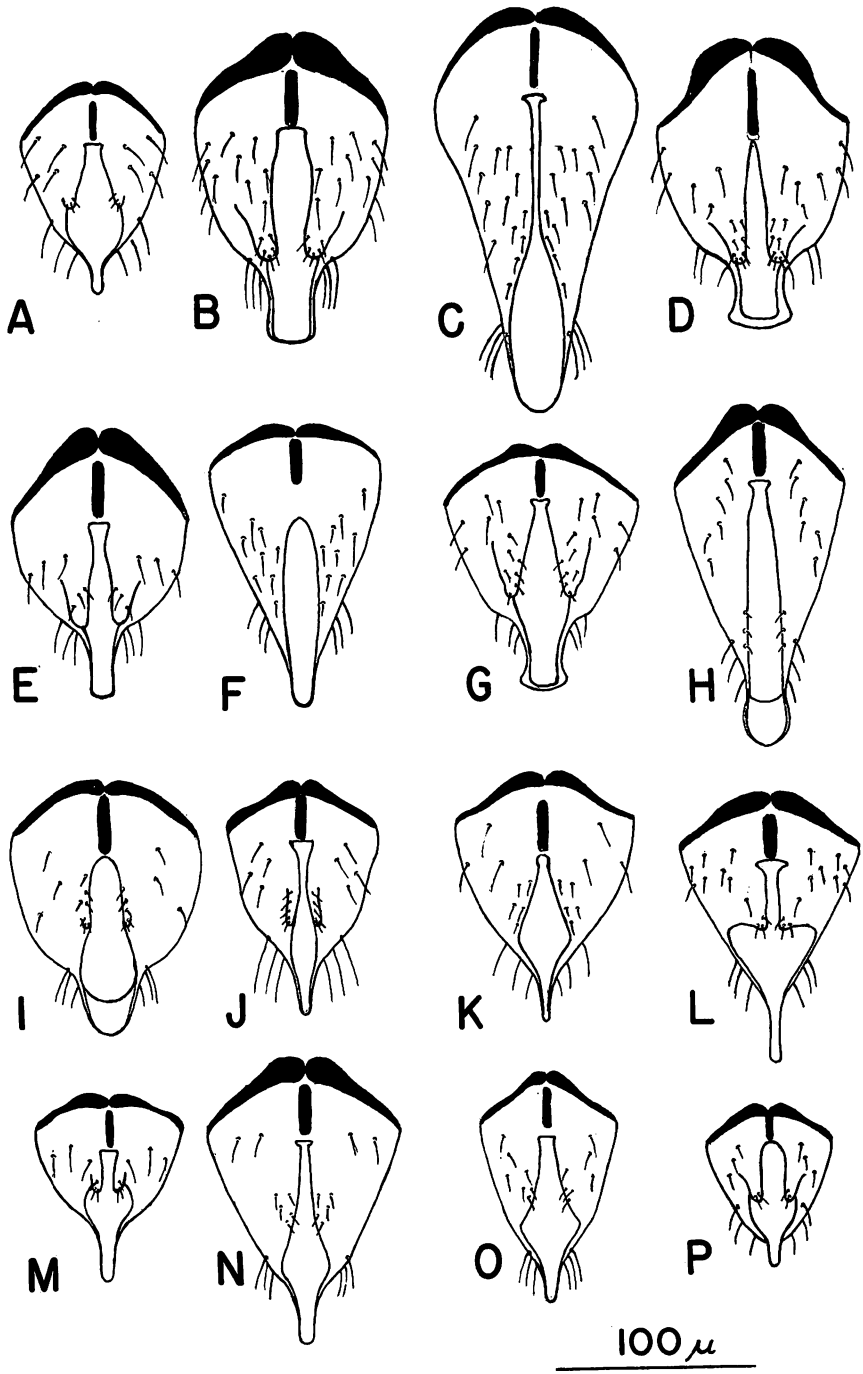
Clavicoccus tribulus Ferris, 1948. Ins. Hawaii 5:174, fig. 99.

Male. Body length about 1.05 mm.; available specimens macropterous. Antennae 10-segmented, about 580 μ total length; 3rd segment about 75 μ long. Antennae clothed with digitiform setae about 42 μ maximum length, plus slender filamentous setae about 48 μ maximum length. Thicker specialized sensory hairs on 3 apical segments about 80 μ maximum length. Head with a sharply defined midcranial ridge; without a noticeably developed dorsomedial sclerite. Eyes moderately large, dorsal pair each about 42 μ in diameter, ventral pair each about 48 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, some with 5; one each side of segments 3 to 8, sometimes with one or more segments without discs on one or both sides; 4 to 6 on each side of segment 2; 3 or 4 on venter of metathorax; 6 to 8 on each side of prothorax; and 1 or 2 on each side of anterior part of head between antennae. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster consisting of 35 to 45 stellate pores. Body clothed with slender filamentous setae about 30 μ maximum length, plus digitiform setae about 24 μ maximum length. Digitiform setae present on both surfaces of abdomen, more numerous on venter.

Penial sheath (fig. 2, D) about 100 μ total length; with a pair of small but readily discernible median lobes; posterior portion tapering to a rounded apex, about 15 μ wide at 9 μ before tip.

Figure 3. Ventral aspects of penial sheaths of: A, *Planococcus citri;* B, *Pseudococcus antricolens;* C, *P. citriculus;* D, *P. dorsispinosus;* E, *P. floriger;* F, *Laminicoccus giffardi;* G, *Pseudococcus lycopodii;* H, *P. maritimus;* I, *P. montanus;* J, *Palmicola palmarum;* K, *Pseudococcus straussiae;* L, *Saccharicoccus sacchari;* M, *Trionymus lounsburyi;* N, *T. multiductus;* O, *T. refertus;* P, *T. rostellum.*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Legs of moderate size, hind femora about 205 μ long; clothed with slender digitiform setae about 24 μ maximum length, plus a few slender filamentous setae about 30 μ maximum length. Claw of hind tarsus about 40 μ long.

Abdominal sclerotization consisting of a broad median transverse patch on dorsum of segment 9; a pair of small patches on venter of segment 9, one on each side of midline; and a moderately large median transverse patch on dorsum of segment 8.

Based on 4 specimens: Mt. Tantalus, Oahu, June 20, 1959 (J. W. Beardsley), reared ex leaves of *Hibiscus arnottianus* Gray.

Dysmicoccus boninsis (Kuwana)

Dactylopius (*Pseudococcus*) *boninsis* Kuwana, 1909. JOUR. NEW YORK ENT. SOC. 17:161.

Pseudococcus boninsis (Kuwana) Morrison, 1929. JOUR. AG. RES. 31(5):489, figs. 2, 3.
Dysmicoccus boninsis (Kuwana) Ferris, 1950 ATLAS OF SCALE INS. OF NO. AMERICA 5:57, fig. 18.

Male. Body length about 1.1 mm.; available specimens macropterous. Antennae 10-segmented, about 630 μ long; 3rd segment about 70 μ long. Antennae clothed with digitiform setae about 36 μ long, plus a few slender filamentous setae about 60 μ maximum length. Thicker specialized sensory hairs on 3 apical segments about 60 μ maximum length. Head with a well defined midcranial ridge dorsally; dorsomedial sclerite not appreciably developed. Eyes moderately small, dorsal pair each about 30 μ in diameter, ventral pair each about 36 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, and occasional one with 3 or 5; a group of 1 to 4 on lateral margins of each of abdominal segments 2 to 8, groups on segments 2, 7 and 8 usually with 1 or 2 more discs than groups on intervening segments. A few discs (usually 6 to 8) on each side of prothorax; a pair of discs usually on anterior part of head between antennae. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster composed of about 60 to 70 closely packed stellate pores. Body clothed with digitiform setae about 30 μ maximum length, plus slender filamentous setae of comparable length or shorter.

Penial sheath (fig. 2, E) about 110 μ total length; median lobes absent or reduced to a pair of barely discernible humps; posterior extension slender, with a moderately truncate tip, about 6 or 7 μ wide at 9 μ before tip.

Legs of moderate size, hind femora about 175 μ long; clothed with conspicuous digitiform setae about 30 μ maximum length, plus a few slender filamentous setae of comparable length. Claw of hind tarsus about 35 μ long.

Abdominal sclerotization consisting of a broad median transverse patch on dorsum of 9th segment; a pair of roughly quadrate patches on venter of 9th segment, one on each side of the midline; 2 medially interrupted transverse patches on dorsum of segment 8, one at the anterior margin and the other near

the posterior margin; and a pair of transverse patches, one on each side of the midline, along the posterior margin on the dorsum of segments 2 to 6, these becoming progressively smaller and weaker posteriorly; dorsum of segment 7 with small irregular patches around the bases of some setae. Other abdominal setae, both dorsal and ventral, with well defined narrow rings of sclerotization about their bases.

Based on 13 specimens: 8, Waialua, Oahu, March, 1959 (J. W. Beardsley), reared ex sugar cane; 5, Honolulu, Oahu, May 13, 1958 (J. W. Beardsley), reared ex sugar cane.

Dysmicoccus neobrevipes Beardsley

Dysmicoccus neobrevipes Beardsley, 1959. PROC. HAW. ENT. SOC. 17(1):31, fig. 1.

Male. Body length about 1.0 mm.; available specimens macropterous. Antennae 10-segmented, about 530 μ long; 3rd segment about 70 μ long. Antennae with both digitiform and slender filamentous setae; digitiform setae about 27 μ maximum length, slender setae up to about 45 μ maximum length. Thicker specialized sensory hairs on 3 apical segments up to about 45 μ maximum length. Head without a well-developed dorsomedial sclerite, with a fairly well-defined midcranial ridge extending dorsally to a point between the dorsal eyes. Eyes of moderate size, dorsal pair each about 30 μ in diameter, ventral pair each about 33 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; 1 to 3 on each side of each of several abdominal segments. Segments 7 and 8 usually with 2 or 3 discs on each side, segments 3 to 6 with 1, 2, or no discs per side, a larger group of 6 to 10 discs on each side of segment 2. One disc usually present just behind each thoracic spiracle; 10 to 15 or so discs on each side of prothorax; occasionally 1 or 2 discs on venter of pro- and meta-thorax between legs. One or two discs usually present on anterior part of head between antennae. Tail-forming pore clusters restricted to pair on 9th abdominal segment; each cluster composed of about 40 stellate pores. Body clothed with interspersed digitiform and slender filamentous setae, the former predominating. Digitiform setae mostly about 20 μ long; slender setae up to about 24 μ maximum length.

Penial sheath (fig. 2, F) about 145 μ long; without discernible median lobes; posterior portion evenly tapered to a blunt, nearly truncate apex about 16 μ wide at 9 μ before tip.

Legs of moderate length, hind femora about 180 μ long; clothed with digitiform setae about 24 μ maximum length plus slender filamentous setae 21 μ maximum length. Claw of hind tarsus about 36 μ long.

Abdominal sclerotization consisting of a broad transverse patch on dorsum of 9th segment; a small patch on each side of the venter of the 9th segment near the base of the penial sheath; a pair of interrupted transverse patches on dorsum of segment 8, one on the anterior margin, the other near the posterior margin; a

pair of small transverse patches on posterior margin of dorsum of segment 2; occasionally a smaller weaker pair at the same position on segment 3. Posterior dorsal ostioles well-developed.

Based on about 15 specimens: Aina Haina, Oahu, Feb.–May, 1958 (J. W. Beardsley), on *Agave sisalana* (Engelm.) Perrine.

Ferrisiana virgata (Cockerell)

Dactylopius virgatus Cockerell, 1893. ENTOMOLOGIST 26:178.
Pseudococcus virgatus (Cockerell) Ferris, 1919. JOUR. ECON. ENT. 12(4):297, fig. 17.
Ferrisia virgatus (Cockerell) Fullaway, 1923. PROC. HAW. ENT. SOC. 5(2):311.
Ferrisiana virgata (Cockerell) Takahashi, 1929. TRANS. NAT. HIST. SOC. FORMOSA 19(104):429.

Male. Body length about 1.4 mm.; available specimens macropterous. Antennae 10-segmented, about 770 μ over-all length; 3rd segment about 120 μ long. Antennae clothed with slender digitiform setae 45 to 50 μ long; slender filamentous setae very scarce, usually but 1 or 2 on basal segments. Thicker specialized sensory hairs of 3 apical segments about 65 μ maximum length.

Head with a moderately well developed dorsomedial sclerite. Eyes moderately large, dorsal pair each about 40 μ in diameter, ventral pair each about 50 μ in diameter.

Dermal discs triangular in outline, with three peripheral loculi; 1 or occasionally 2 on each side of abdominal segments 3 to 7; 1 or 2 behind each spiracle; 1 or 2 on each anterior lateral angle of the prothorax. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster containing about 50 closely packed stellate pores. Body sparsely clothed with slender filamentous setae mostly 25 to 30 μ long. Digitiform setae absent except on antennae and legs.

Penial sheath (fig. 2, G) about 150 μ over-all length; without discernible median lobes; tapering posteriorly to a broadly rounded apex about 25 μ wide at 9 μ before tip.

Legs relatively long, hind femora about 270 μ in length; clothed with very long digitiform setae, mostly 65 to 80 μ in length, plus a very few small slender setae about 15 μ or less in length. Claw of hind tarsus about 37 μ long.

Abdominal sclerotization consisting of a broad median transverse patch on dorsum of segment 9, plus a pair of small areas on venter of segment 9, one on each side of the midline. Dorsum of segment 8 with two interrupted transverse sclerotized areas, the more distinct one near the posterior margin, the anterior one much less distinct and broadly interrupted at its center. A pair of well-defined transverse streaks, one on each side of the midline, near the posterior margin of the dorsum of segment 2, plus a much smaller, weaker pair of streaks in the same position on segment 3. Bases of abdominal setae, particularly those of the posterior segments, surrounded by narrow rings of sclerotization.

Based on 6 specimens: Honolulu, Oahu, April 1959 (J. W. Beardsley), on leaves of croton.

Pedronia acanthocauda Beardsley

Pedronia acanthocauda Beardsley, 1957. PROC. HAW. ENT. SOC. 16(2):230, fig. 5.

Male. Body length about 1.1 mm.; available specimens macropterous. Antennae 10-segmented, about 560 μ total length; 3rd segment about 80 μ long. Antennae clothed with digitiform setae about 35 μ maximum length, plus a few slender filamentous setae about 60 μ maximum length. Three apical segments with slightly thicker specialized sensory setae about 40 μ maximum length. Head with a weak midcranial ridge dorsally; dorsomedial sclerite not noticeably developed. Eyes relatively small, dorsal pair each about 23 μ in diameter, ventral pair each about 26 μ in diameter.

Dermal discs very few, those present with 4 peripheral loculi; distributed along lateral margins of abdomen, 1 to 3 on each side, not more than 1 per side on any segment in available specimens. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster consisting of 20 to 25 stellate pores. Body sparsely clothed with slender filamentous setae about 25 μ maximum length. Digitiform setae, about 30 μ maximum length, fairly numerous on head, a few on venter of prothorax, and 1 or 2 on venter of basal abdominal segments in one specimen.

Penial sheath (fig. 2, K) about 120 μ total length; median lobes represented by barely discernible humps; posterior portion tapering evenly to a rounded apex, about 9 or 10 μ wide at 9 μ before tip.

Legs of moderate size, hind femora about 165 μ long; clothed with digitiform setae about 27 μ maximum length, plus a very few slender filamentous setae of comparable length. Claw of hind tarsus about 30 μ long.

Abdominal sclerotization strongly developed, consisting of a series of broad transverse ventral patches, one on each of segments 5 to 9, plus smaller less strongly sclerotized patches on venter of segments 2 to 4; dorsum with similar patches on segments 7 to 9, a reduced or incomplete patch, consisting of incompletely separated anterior and posterior transverse patches, on dorsum of segment 6.

Based on 2 specimens: Summit, Poamoho Trail, Oahu, Jan. 1, 1959 (J. W. Beardsley), reared ex *Dicranopteris owhyhensis* Hooker.

Pedronia cibotii Beardsley

Pedronia cibotii Beardsley, 1957. PROC. HAW. ENT. SOC. 16(2):222, fig. 2

Male. Body length about 1.0 mm.; available specimens macropterous. Antennae 10-segmented, about 540 to 600 μ total length; 3rd segment about 72 μ long. Antennae clothed with slender digitiform setae about 34 μ maximum length, plus a few slender filamentous setae about 45 μ maximum length. Slightly thicker

specialized sensory setae, about 45 μ maximum length, present on 3 apical segments. Head with a weakly developed dorsomedial sclerite, and a well-defined dorsal midcranial ridge. Eyes small, dorsal pair each about 24 μ in diameter, ventral pair each about 27 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5. One to 3 discs on each side of most abdominal segments 3 to 8, sometimes absent from 1 or both sides of 1 or 2 segments; 1 to 3 on each side of segment 2; apparently absent on thorax and head. Tail-forming pore clusters confined to pair on 9th abdominal segment, each cluster consisting of around 20 to 25 stellate pores. Body clothed with digitiform setae about 30 μ maximum length, plus slender filamentous setae mostly 18 μ long or less, a few longer filamentous setae up to about 36 μ in length along lateral margins of abdominal segments near dermal discs. Digitiform setae moderately numerous on head; usually 1 to 4 on venter of each segment of abdomen; 1 or 2 on dorsum of basal abdominal segment.

Penial sheath (fig. 2, L) about 120 μ total length; median lobes represented by a pair of very small humps; posterior portion tapering to a short, rounded apex, about 9 μ wide at 9 μ before tip.

Legs of moderate length, hind femora about 165 μ long; clothed with digitiform setae about 30 μ maximum length, plus a few slender filamentous setae about 24 μ maximum length. Claw of hind tarsus about 28 μ long.

Abdominal sclerotization consisting of a broad median transverse patch on dorsum of 9th segment, a pair of small weak transverse patches on venter of 9th segment; plus a pair of weak transverse patches, one each side of midline near posterior margin of dorsum of segment 2. Setae of abdomen, particularly those of the posterior segments, with narrow rings of sclerotization around their bases.

Based on 10 specimens: Mt. Tantalus, Oahu, June 20, 1959 (J. W. Beardsley), reared ex fronds of *Cibotium chamissoi* Kaulfuss.

Pedronia crypta Beardsley

Pedronia crypta Beardsley, 1957. PROC. HAW. ENT. SOC. 16(2):226, fig. 4.

Male. Over-all length about 1.0 mm.; available specimen macropterous. Antennae 10-segmented, short, about 450 μ total length; 3rd segment about 50 μ long. Antennae clothed with slender digitiform setae about 35 μ maximum length, plus a few slender filamentous setae about 45 μ maximum length. Thicker specialized sensory setae on 3 apical segments about 45 μ maximum length. Head with a moderately well-defined dorsomedial sclerite with a darker central midcranial ridge. Eyes small, dorsal pair each about 20 μ in diameter, ventral pair each about 24 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 5; 1 each side of most of abdominal segments 2 to 8, absent from one or both sides of 1 or 2 segments; 2 discs on one side of segment 4 in only available specimen; 1 or 2

discs on each side of prothorax. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster consisting of 25 to 30 stellate pores. Body sparsely clothed with slender filamentous setae mostly about 27 μ or less in length, a few longer setae up to about 33 μ long on lateral margins of posterior abdominal segments. Around 25 digitiform setae about 30 μ maximum length on head, plus a few (only 3 in specimen at hand) on venter of abdomen.

Penial sheath[1] about 95 μ total length; median lobes represented by a pair of barely discernible humps; posterior portion evenly tapered to a rounded apex about 8 or 10 μ wide at 9 μ before tip.

Legs moderately short, hind femora about 140 μ long; clothed with digitiform setae about 30 μ maximum length, plus a few slender filamentous setae of comparable length. Claw of hind tarsus about 25 μ long.

Abdominal aclerotization consisting of a median transverse patch on dorsum of segment 9; similar, less distinct, and more irregular patches on dorsum of segments 7 and 8; a pair of patches on venter of segment 9, 1 on each side of midline near base of penial sheath. Setae of abdomen with narrow weak rings of sclerotization around their bases.

Based on 1 specimen: Kahalau Lookout, Kokee, Kauai, August 30, 1959 (J. W. Beardsley), reared ex *Dicranopteris owhyhensis* Hooker.

Pedronia hawaiiensis Ferris

Pedronia hawaiiensis Ferris, 1948. INS. HAWAII 5:168, fig. 97.

Male. Body length about 1.0 mm.; available specimens macropterous. Antennae 10-segmented, about 600 μ total length; 3rd segment about 80 μ long. Antennae clothed with digitiform setae about 36 μ maximum length, plus a few slender filamentous setae about 45 μ maximum length. Specialized sensory setae of 3 apical segments about 40 μ maximum length. Head with a moderately well-developed dorsomedial sclerite. Eyes small, dorsal pair each about 22 μ in diameter, ventral pair head about 26 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, a few with 3 or 5; 1 each side of most abdominal segments 2 to 8, occasionally absent on 1 or both sides of 1 or more segments; apparently absent on head and thorax. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster consisting of 30 to 35 stellate pores. Body sparsely clothed with slender filamentous setae mostly about 24 μ maximum length, a few on lateral margins of abdominal segments near dermal discs up to about 45 μ maximum length. Slender digitiform setae, about 24 μ maximum length, on head, venter of thorax, plus a very few sometimes on venter of abdomen (not more than 2 or 3 in available specimens).

Penial sheath (fig. 2, M) about 105 μ total length; median lobes represented by small humps; posterior portion tapering to a rounded apex about 10 μ wide at 9 μ before tip.

[1] The penial sheath of the male of this species has not been figured as it is imperfectly aligned in the only specimen available.

Legs moderately small, hind femora about 150 μ long; clothed with slender digitiform setae about 30 μ maximum length, plus a few slender filamentous setae of comparable length. Claw of hind tarsus about 28 μ long.

Abdominal sclerotization consisting of a broad transverse median patch on dorsum of segment 9; a pair of small patches on venter of segment 9, 1 on each side of midline. Setae of abdomen with narrow rings of sclerotization around their bases.

Based on 6 specimens: Aiea Loop Trail, Oahu, May, 1959 (J. W. Beardsley), reared ex *Dicranopteris linearis* (Burmeister) Underwood.

Males of this species are very close to those of *P. cibotii*. Although most of the specimens of the later species have slightly longer penial sheaths than *P. hawaiiensis*, there appears to be some overlap in the range of this character in the two species. For the present, I am unable to find any structural characters suitable for unequivocal separation of these 2 forms in the male sex.

Phenacoccus gossypii Townsend and Cockerell

Phenacoccus gossypii Townsend and Cockerell, 1898. JOUR. NEW YORK ENT. SOC. 6(3):170.

Male. Body length about 1.4 mm.; available specimens macropterous. Antennae 10-segmented, about 1.2 mm. total length; 3rd segment about 150 μ long. Antennae clothed with slender digitiform setae about 45 μ maximum length, plus a few slender filamentous setae of comparable length. Specialized sensory hairs of 3 apical segments only slightly thicker than digitiform setae, about 60 μ maximum length. Dorsomedial sclerite of head not strongly developed. Midcranial ridge broad dorsally with irregular margins, not interrupted above juncture of the two lateral branches as in other species studies. Eyes large, very prominent, dorsal pair each about 57 μ in diameter, ventral pair each about 60 μ in diameter.

Dermal discs apparently all stellate, with 5 peripheral loculi; 1 to 4 on each side of abdominal segments 2 to 7, plus several (2 to 4) in a row across the dorsum of these segments; 1 or 2 on each side of anterior part of prothorax. Abdomen with a pair of tail-forming pore clusters on both segments 8 and 9. Clusters of 8th segment each with 35 to 40 stellate pores, those of 9th segment each with about 45 to 50 such pores. Body sparsely clothed with slender filamentous setae mostly 28 to 30 μ long, a few up to 45 μ long on lateral margins of posterior adbominal segments. Digitiform setae apparently confined to antennae and legs.

Penial sheath (fig. 2, N) about 105 to 110 μ long; without discernible median lobes; posterior portion tapering to a slender apex about 6 or 7 μ wide at 9 μ before tip; ventral portion of sheath largely membranous, not completely sclerotized as in other species studied (sclerotized areas indicated by stippling in figure). Extent of ventral slit not definitely discernible in the specimens available.

Legs relatively long, hind femora about 245 μ in length; clothed with slender digitiform setae about 30 μ in maximum length plus a few slender filamentous

setae of comparable length. Claw of hind tarsus about 40 μ long, without the small tooth on the inner surface characteristic of females of the genus.

Abdominal sclerotization consisting of a series of dorsal patches, a pair of which appear to lie on the anterior margin of abdominal segments 3 to 7, one on each side of the midline. Segments 5 to 7 each bearing in addition a narrow, interrupted, median, transverse patch near the posterior margin. Dorsum of segment 8 with a pair of irregular patches on each side of the midline. Sclerotization of venter of abdomen consisting of small patches around the bases of the setae.

Based on 2 specimens: 1, Foster Gardens, Honolulu, Oahu, July 7, 1937 (C. E. Pemberton), on leaf of *Erythrina caffra* Thunb.; 1, Honolulu, Oahu, Aug. 26, 1954 (J. W. Beardsley), on *Buddleia davidi* Franch.

Males of this species exhibit the most distinctive features of any studied.

Phylococcus oahuensis (Ehrhorn)

Cissococcus (?) *oahuensis* Ehrhorn, 1912. PROC. HAW. ENT. SOC. 2(4):149, pl.5.
Phylococcus oahuensis (Ehrhorn) Ehrhorn 1916. PROC. HAW. ENT. SOC. 3(3):236.

Male. Body length about 1.25 mm.; available specimens macropterous. Antennae 10-segmented, about 665 μ total length; 3rd segment about 80 μ long. Antennae clothed with slender digitiform setae about 36 μ maximum length, plus a few slender filamentous setae about 60 μ maximum length. Three apical segments with thicker specialized sensory hairs up to about 50 μ maximum length. Head with a prominent midcranial ridge dorsally; with a weakly developed dorsomedial sclerite. Eyes of moderate size, dorsal pair each about 32 μ in diameter, ventral pair each about 35 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed on lateral margins of abdomen, 1 or 2 on each side of most of segments 3 to 8; sometimes absent on one or both sides of one or more segments; 3 to 5 on each side of segment 2; 2 or 3 on each side of prothorax. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster composed of 40 to 50 stellate pores. Body sparsely clothed with slender filamentous setae about 33 μ maximum length. Digitiform setae confined to antennae, legs, and head; those of head about 30 μ maximum length.

Penial sheath (fig. 2, O) about 120 μ total length; without discernible median lobes; posterior extension evenly tapered to a rounded apex, 9 or 10 μ wide at 9 μ before tip. Posterior extension somewhat elongate, about one-third the total length of the sheath.

Legs of moderate length, hind femora about 200 μ long; clothed with slender digitiform setae about 33 μ maximum length, plus a very few slender filamentous setae of comparable length. Claw of hind tarsus about 30 μ long.

Abdominal sclerotization consisting of a broad median transverse patch on dorsum of segment 9; and a pair of small patches on venter of segment 9, one on each side near base of penial sheath.

Based on 2 entire and 4 fragmentary specimens removed from galls on leaves of hebarium specimens of *Urera glabra*; collected in Mts. near Koele, Lanai, June, 1913 (C. N. Forbes).

Planococcus citri (Risso)

Dorthesia citri Risso, 1813. HIST. NAT. DES ORANGES
Dactylopius citri (Risso) Signoret, 1875. ANN. ENT. SOC. FRANCE (5), vol. 5:312.
Pseudococcus citri (Risso) Fernald, 1903. CAT. COCCIDAE OF THE WORLD, p. 99.
Planococcus citri (Risso) Ferris, 1950. ATLAS OF SCALE INS. OF NO. AMERICA 5:165, fig. 63.

Male. Body length about 1.0 mm.; available specimens macropterous. Antennae 10-segmented, 610 to 620 μ total length; 3rd segment about 75 μ long. Antennae clothed with digitiform setae about 27 μ maximum length, plus slender filamentous setae about 45 μ maximum length. Three apical segments with thicker specialized sensory hairs about 45 μ maximum length: Head with a well-defined dorsomedial sclerite; without a discernible dorsal midcranial ridge. Eyes of moderate size, dorsal pair each about 33 μ in diameter, ventral pair each about 36 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed on lateral margins of abdomen, 1 to 5 on each side of each of segments 3 to 8, 8 to 16 on each side of segment 2; 4 to 6 on each side of prothorax; 1 or 2 on each side of anterior portion of head between antennae. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster consisting of about 50 to 60 stellate pores. Body sparsely clothed with slender filamentous setae about 27 μ maximum length. Digitiform setae confined to antennae and legs.

Penial sheath (fig. 3, A) about 105 μ total length; with a pair of small but readily discernible median lobes; posterior extension slender, about 6 μ wide at 9 μ before tip, apex rounded.

Legs of moderate length, hind femora about 185 μ long; clothed with digitiform setae about 27 μ maximum length, plus a few slender filamentous setae about the same length. Claw of hind tarsus about 40 μ long.

Abdominal sclerotization consisting of a broad median transverse patch on dorsum of 9th segment; a pair of small patches on venter of 9th segment, one on each side near base of penial sheath; a pair of small transverse patches, one on each side of midline, on posterior margin of dorsum of segment 2; a pair of smaller patches in a similar position of dorsum of segment 3. Setae of posterior abdominal segments, particularly those of venter, with very narrow rings of weak sclerotization about their bases.

Based on about 20 specimens: Honolulu, Oahu, June 1959 (J. W. Beardsley), reared ex laboratory culture on potato sprouts.

Pseudococcus antricolens Ferris

Pseudococcus antricolens Ferris, 1948 INS. HAWAII 5:181, fig. 102.

Male. Body length about 1.3 mm.; available specimens macropterous. Antennae 10-segmented, about 640 μ total length; 3rd segment about 90 μ long. Antennae clothed with slender digitiform setae about 33 μ maximum length, plus a few slender filamentous setae about 30 μ maximum length. Thicker specialized sensory setae of 3 apical segments about 45 μ maximum length. Head with a broad dorsomedial sclerite. Eyes moderately large, ventral pair each about 39 μ in diameter, ventral pair each about 42 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed along lateral margins of abdomen, 1 or 2 on each side of all or most of abdominal segments 3 to 7, 2 or 3 on each side of segment 8, 3 to 6 on each side of prothorax; 3 or 4 on each side of midcranial suture on front part of head between antennae. Tail-forming pore clusters restricted to pair on 9th segment of abdomen; each cluster composed of 50 to 60 stellate pores. Body clothed with digitiform setae about 28 μ maximum length, plus slender filamentous setae mostly 24 μ long or less; digitiform setae predominating on venter of abdomen, relatively few on dorsum of abdomen.

Legs of moderate length, hind femora about 200 μ long; clothed with digitiform setae about 33 μ maximum length, plus a very few slender filamentous setae. Claw of hind tarsus about 34 μ long.

Penial sheath (fig. 3, B) about 160 μ total length; with a well-developed pair of median lobes. Posterior portion with tip nearly truncate, slightly expanded, about 27 or 28 μ wide across expanded portion.

Abdominal sclerotization consisting of a large median transverse patch on dorsum of 9th segment; a pair of very small patches on venter of segment 9, one on each side near base of penial sheath; a small, interrupted, transverse patch near the posterior margin of dorsum of segment 8; a pair of small transverse patches, one on each side of the mid-line, along posterior margin of dorsum of segments 2 and 3. Setae of posterior abdominal segments with very narrow rings of sclerotization around their bases.

Based on 7 specimens: Aiea Loop Trail, Oahu, June, 1959 (J. W. Beardsley), reared from leaf galls ex *Santalum freycinetianum* Gaud.

There appears to be a complex of species or subspecies related to *Pseudococcus gallicola* Ehrhorn and *P. antricolens* Ferris which occur on the various species of *Santalum* in the Hawaiian Islands. These will require careful collecting and study before their relationships are clear. I have collected two forms on Oahu, and one each on Kauai and Hawaii, but none of these exactly fit Ferris' concept of either to the two described species mentioned above. The females associated with males described above seem to be quite close to *P. antricolens* except that the antennae are 8-segmented in all but one specimen, and that has one 8- and one 7-segmented antenna. *P. antricolens* was described as having 7-segmented

antennae. Although Ferris placed considerable emphasis on this character in separating *P. antricolens* and *P. gallicola*, it has been my experience that in endemic Hawaiian mealybugs the number of antennal segments frequently varies between 7 and 8 segments in specimens from a single population, and sometimes even on opposite sides of the same specimen.

Pseudococcus citriculus Green

Pseudococcus citriculus Green, 1922. COCCIDAE OF CEYLON 5:377, pl. 154.

Male. Body length about 1.2 mm.; available specimens macropterous. Antennae clothed with rather slender digitiform setae about 30 μ maximum length, plus a few slender filamentous setae about 33 μ maximum length. Thicker specialized sensory hairs, 50 to 60 μ long, present on three apical segments. Head with a sharply defined midcranial suture dorsally, without a discernible dorsomedial sclerite. Eyes of moderate size, dorsal pair each about 34 μ in diameter, ventral pair each about 38 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 5; distributed on lateral margins of abdominal segments, 1 or 2 on each side of segments 3 to 7, 3 or 4 on each side of segments 2 and 8; 3 or 4 discs on each side of prothorax; usually 2 on anterior part of head between antennae. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster composed of around 40 to 50 stellate pores. Body clothed with digitiform setae about 29 μ maximum length, plus slender filamentous setae 39 μ maximum length.

Penial sheath (fig. 3, C) about 200 μ total length; without discrenible median lobes; tapering evenly to a rounded apex, about 22 μ wide at 9 μ before tip.

Legs moderately large, hind femora about 180 μ long; clothed with digitiform setae up to about 30 μ long, plus a very few slender filamentous setae, about 39 μ maximum length (on hind femora). Claw of hind tarsus about 36 μ long.

Abdominal sclerotization consisting only of a transverse patch on the dorsum of the 9th segment.

Based on 2 specimens: Manoa Valley, Oahu, May 1, 1945 (E. C. Zimmerman), on Pomelo.

Pseudococcus dorsispinosus Beardsley

Pseudococcus dorsispinosus Beardsley, 1959. PROC. HAW. ENT. SOC. 17(1):40, fig. 1.

Male. Body length about 1.2 mm.; available specimens macropterous. Antennae 10-segmented, about 640 μ total length; 3rd segment about 90 μ long. Antennae clothed with slender digitiform setae about 30 μ maximum length, plus a few slender filamentous setae about 40 μ maximum length. Thicker specialized sensory setae of 3 apical segments about 48 μ maximum length. Midcranial ridge becoming broader dorsally, its margins irregular, appearing like a very narrow dorsomedial sclerite, widening somewhat toward its posterior end.

Eyes moderately large, dorsal pair each about 36 μ in diameter, ventral pair each about 45 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed along lateral margins of abdomen, some or all of segments 3 to 7 with 1 such disc on each side, segments 2 and 8 each usually with 2 discs on each side; 4 or 5 discs on each side of prothorax; 2 or 3 discs on each side of anterior part of head between antennae. Tail-forming pore clusters restricted to pair on 9th abdominal segment; each cluster with 30 to 40 stellate pores. Body clothed with both digitiform and slender filamentous setae, both types about 27 μ maximum length; digitiform setae predominating on head and venter of abdomen, less numerous on dorsum of abdomen.

Legs of moderate length, hind femora about 195 μ long; clothed with digitiform setae about 39 μ maximum length, plus a few slender setae about 50 μ maximum length. Claw of hind tarsus about 42 μ long.

Penial sheath (fig. 3, D) about 148 μ total length; with a pair of well developed median lobes; posterior portion with the tip slightly rounded, noticeably expanded and relatively very broad, about 35 or 36 μ wide across expanded part of tip.

Abdominal sclerotization consisting of a broad transverse patch on dorsum of segment 9; two small patches on venter of segment 9, one on each side of the midline; a small median transverse patch near posterior margin, and a pair of small transverse patches one on either side of the midline on the anterior margin of the dorsum of segment 8; a small interrupted median transverse patch on dorsum of segment 7; a pair of small transverse patches one on each side on the posterior margin of the dorsum on segments 2, 3, and 4. Bases of abdominal setae surrounded by well-defined rings of sclerotization, particularly on the posterior segments of the venter.

Based on 3 specimens: Mt. Tantalus, Oahu, July 4, 1956 (J. W. Beardsley), on leaves of *Pipturus*.

Pseudococcus floriger Ferris

Pseudococcus floriger Ferris, 1948. Ins. Hawaii 5:212, fig. 120.

Male. Body length about 1.0 mm.; available specimens macropterous. Antennae 10-segmented; relatively short, about 400 to 425 μ over-all length; 3rd segment about 54 μ long. Antennae clothed with both digitiform and slender filamentous setae, the former predominating. Digitiform setae about 24 μ maximum length, slender setae about 33 μ maximum length. Thicker specialized sensory setae about 42 μ maximum length present on last 3 segments. Midcranial suture of head broadened dorsally, its margins irregular, appearing like a very narrow dorsomedial sclerite. Eyes small; dorsal pair each about 23 μ in diameter, ventral pair each about 25 μ in diameter.

Dermal discs mostly with 4 peripheral loculi; distributed along lateral margins of abdomen, 1 or 2 on each side of majority of abdominal segments 3 to 8;

3 or 4 on each side of abdominal segment 2; about 4 to 6 on each side of the prothorax; and 1 or 2 on anterior part of head between antennae. Tail-forming pore clusters restricted to pair on 9th abdominal segment; each cluster composed of 35 to 40 stellate pores. Body sparsely clothed with slender filamentous setae mostly 24 to 30 μ long. Digitiform setae restricted to legs, antennae, and head; those of head about 22 μ maximum length.

Penial sheath (fig. 3, E) about 135 μ over-all length; with a pair of well-developed median lobes; posterior extension with the tip nearly truncate, slightly expanded, about 10 μ wide.

Legs fairly small, hind femora about 135 to 140 μ long; clothed with digitiform and slender setae, both types about 24 μ maximum length on hind femora. Claw of hind tarsus about 26 μ long.

Abdominal sclerotization consisting of a broad transverse patch on dorsum of 9th segment; two small patches on venter of 9th segment, one on each side near base of penial sheath; a pair of narrow transverse patches along the anterior margin of dorsum of segment 8, one on each side of the midline. Setae of abdominal segments, particularly the posterior ones, with bases surrounded by well-developed narrow sclerotized rings or small patches.

Based on 5 specimens: Wailupe Valley, Oahu, December 26, 1956 (J. W. Beardsley), in crowns of *Dracaena aurea* Mann.

Pseudococcus lycopodii Beardsley

Pseudococcus lycopodii Beardsley, 1959. PROC. HAW. ENT. SOC. 17(1):44, fig. 2.

Male. Body length about 1.2 mm.; available specimens macropterous. Antennae 10-segmented, about 730 μ total length; 3rd segment about 105 μ long. Antennae clothed with relatively very slender digitiform setae about 45 μ maximum length, plus a few more slender filamentous setae about 45 μ maximum length. Thicker specialized sensory setae, 40 to 60 μ long, present on 3 apical segments. Head with a poorly defined dorsomedial sclerite, its lateral margins irregular, but bisected by a well-defined midcranial ridge. Eyes of moderate size, dorsal pair each about 32 μ in diameter, ventral pair each about 36 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed along lateral margins of abdomen, 1 on each side of most of segments 3 to 7, usually 2 on each side of segment 8, and 4 to 6 on each side of segment 2; 4 to 6 on each side or prothorax; 2 on anterior part of head between antennae. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster composed of 50 to 60 stellate pores. Body clothed with digitiform setae about 36 μ maximum length, and slender filamentous setae about 30 μ maximum length. Digitiform setae about as numerous on dorsum of abdomen as on the venter.

Penial sheath (fig. 3, G) about 145 μ total length; with a well-developed pair of median lobes; posterior extension with the tip nearly truncate, slightly expanded, about 24 or 25 μ wide across expanded portion.

Legs moderately large, hind femora about 195 μ long; clothed with long digitiform setae about 45 μ maximum length on hind femora, plus a few slender filamentous setae about 30 μ maximum length. Claw of hind tarsus about 37 μ long.

Abdominal sclerotization consisting of a median transverse patch on dorsum of 9th segment; 2 small transverse patches on venter of segment 9, one on each side of the midline near base of penial sheath; a pair of small transverse patches, one on each side of the midline, on posterior margin of dorsum of segments 2 and 3.

Based on 15 specimens: Summit, Poamoho Trail, Oahu, January 1, 1959 (J. W. Beardsley), bred ex *Lycopodium cernuum* L.

Laminicoccus giffardi (Ehrhorn)

Tylococcus giffardi Ehrhorn, 1916. PROC. HAW. ENT. SOC. 3(3):243.
Pseudococcus giffardi (Ehrhorn) Zimmerman, 1948. INS. HAWAII 5:219, fig. 122.
Laminicoccus giffardi (Ehrhorn) Williams, 1960. BULL. BRITISH. MUS. (NAT. HIST) ENT. 8(10):402.

Male. Body length about 1.1 mm.; available specimens macropterous. Antennae 10-segmented, short, about 450 to 470 μ total length; 3rd segment about 65 μ long. Antennae clothed with short digitiform setae about 18 μ maximum length, plus longer slender filamentous setae about 30 μ maximum length. A specialized sensory hair up to about 36 μ long, as thick or thicker than digitiform setae, on each of 3 apical segments. Head with sharply defined midcranial ridge dorsally; without a well-defined dorsomedial sclerite. Eyes small, dorsal pair each about 24 μ in diameter, ventral pair each about 27 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed along lateral margins of abdomen, 3 to 5 discs on each side of segments 3 to 7; 4 to 6 each side of segment 8; 12 to 16 each side of segment 2; 15 to 20 each side of prothorax; 1 to 3 on each side of anterior part of head between antennae. Tail-forming pore clusters confined to 9th abdominal segment; each cluster composed of 35 to 45 stellate pores. Body clothed with moderately numerous slender filamentous setae mostly 20 to 33 μ long, some of those on head considerably longer, up to about 45 μ long. A relatively very few digitiform setae, about 18 μ long, present on head and abdomen, most numerous on venter of head, 1 to 4 on dorsum of each of several abdominal segments, a comparable number on venter.

Penial sheath (fig. 3, F) about 140 μ total length; without discernible median lobes; posterior portion tapering to a rounded apex about 14 μ wide at 9 μ before tip.

Legs of moderate length, hind femora about 175 to 180 μ long; clothed with slender filamentous setae about 35 μ maximum length, plus a few digitiform setae about 18 μ maximum length. Claw of hind tarsus about 30 μ long.

Abdominal sclerotization consisting of a median transverse patch on dorsum of segment 9; a median transverse patch near anterior margin of venter of segment 9; a median transverse patch along anterior margin of dorsum of segment 8; a similar but interrupted patch on dorsum of segment 7; small median transverse patches on anterior margin of venter of segments 7 and 8. Setae of posterior abdominal segments, particularly those located near the midline on both dorsum and venter, with conspicuous rings or small patches of sclerotization about their bases.

Based on 6 specimens: Aina Haina, Oahu, March, 1959, (J. W. Beardsley), reared ex *Pandanus* crown.

Pseudococcus maritimus (Ehrhorn)

Dactylopius maritimus Ehrhorn, 1900. CANAD. ENT. 32(10):316, pl. 7, fig. 7.
Pseudococcus maritimus (Ehrhorn) Fernald, 1903. CAT. OF THE COCCIDAE OF THE WORLD, p. 106.

Male. Body length about 1.25 mm., available specimens macropterous. Antennae 10-segmented, about 640 μ total length; 3rd segment about 90 μ long. Antennae clothed with digitiform setae about 25 μ maximum length, plus a few slender filamentous setae about 33 μ maximum length. Thicker specialized sensory setae about 36 μ maximum length on 3 apical segments. Head with a well-developed midcranial suture; dorsomedial sclerite present but weakly developed. Eyes of moderate size, dorsal pair each about 33 μ in diameter, ventral pair each about 39 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed along lateral margins of abdomen, 1 to 3 on each side of abdominal segments 3 to 7, 3 or 4 on each side of segment 8, 6 to 10 on each side of segment 2; 6 to 10 on each side of prothorax; about 2 on each side of anterior portion of head between antennae. Tail-forming pore clusters confined to 9th abdominal segment; each cluster composed of 40 to 50 stellate pores. Body clothed with digitiform setae about 21 μ maximum length, plus slender filamentous setae about 25 μ maximum length.

Penial sheath (fig. 3, H) about 175 μ total length; without discernible median lobes; posterior portion slightly expanded before tip, about 30 μ wide across expanded portion.

Legs moderately long, hind femora about 205 μ in length; clothed with digitiform setae about 25 μ maximum length, plus a very few slender filamentous setae about 24 μ maximum length. Claw of hind tarsus about 38 μ long.

Abdominal sclerotization consisting of a broad transverse patch on dorsum of 9th segment; a pair of small irregularly shaped patches on venter of segment 9, one on each side near base of penial sheath; an irregular median transverse patch near posterior margin of dorsum of segment 8; a pair of small transverse patches, one on each side of the midline, on anterior margin of dorsum of segments 3 to 8,

decreasing in size posteriorly on segments 4, 5, and 6, increasing slightly on segments 7 and 8. Bases of abdominal setae, particularly those of the posterior segments, surrounded by narrow rings of sclerotization. Dorsal ostioles quite well developed.

Based on 2 specimens: Manoa Valley, Oahu, May 24, 1939 (O. H. Swezey), on *Crossandra*.

Pseudococcus montanus Ehrhorn

Pseudococcus montanus Ehrhorn, 1916. PROC. HAW. ENT. SOC. 3(3):242.

Male. Body length about 1.1 mm.; available specimens macropterous. Antennae 10-segmented, about 450 to 550 μ total length; 3rd segment about 65 μ long. Antennae clothed with slender digitiform setae about 24 μ maximum length, plus slender filamentous setae mostly 30 to 45 μ long. Thicker specialized sensory hairs on 3 apical segments about 50 μ maximum length. Head with dorsomedial sclerite moderately well-developed, its lateral edges irregular. Eyes of moderate size, dorsal pair each about 30 μ in diameter, ventral pair each about 36 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed along lateral margins of abdomen, 1 to 4 on each side of abdominal segments 3 to 7, 2 to 4 on each side of segment 8, 6 to 12 on each side of segment 2; 8 to 10 on each side of prothorax, 1 or 2 on each side of midcranial ridge on anterior portion of head between antennae. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster consisting of 30 to 40 stellate pores. Body sparsely colthed with digitiform and slender setae, the former much less numerous than the latter. Digitiform setae about 24 μ maximum length, fairly numerous on head, relatively few on abdomen, there confined almost entirely to venter, 2 to 4 on venter of most segments; slender setae mostly 27 μ long or less, a few longer ones associated with groups of dermal discs on lateral margins of abdominal segments, particularly on posterior segments, these up to about 45 μ long on 7th and 8th segments.

Penial sheath (fig. 3, I) about 135 μ long; median lobes wanting or represented by a pair of barely discernible humps; posterior portion tapering evenly to a bluntly rounded apex about 24 μ wide at 9 μ before tip.

Legs of moderate length, hind femora about 185 μ long; clothed with digitiform setae about 27 μ maximum length, plus slender filamentous setae about 30 μ maximum length. Claw of hind tarsus about 37 μ long.

Abdominal sclerotization consisting of a broad median transverse patch on dorsum of 9th segment; a pair of small patches on venter of 9th segment, one on each side near base of penial sheath; an interrupted median transverse band near the posterior margin of the dorsum of segment 8; a pair of small transverse bands on anterior margin of dorsum of segment 8, one on each side of the midline; a pair of transverse patches on the anterior margin of the dorsum of segment 3,

one on each side of the midline; sometimes a smaller pair of patches in this position on segment 4. Rings or small patches of sclerotization about some setae on posterior abdominal segments.

Based on 8 specimens: Mt. Tantalus, Oahu, June 20, 1959 (J. W. Beardsley), reared ex *Freycinetia arborea* Guadichaud.

Palmicola palmarum (Ehrhorn)

Ripersia palmarum Ehrhorn, 1916. PROC. HAW. ENT. SOC. 3(3):245.
Pseudococcus palmarum (Ehrhorn) Zimmerman, 1948. INS. HAWAII 5:235, fig. 130.
Palmicola palmarum (Ehrhorn) Williams, 1960. BULL. BRITISH MUS. (NAT. HIST.) ENT. 8(10):415.

Macropterous male. Body length about 1.0 mm. Antennae 9-segmented; about 300 μ total length; 3rd segment about 40 μ long. Antennae clothed with short digitiform setae about 15 μ maximum length, plus longer slender filamentous setae about 30 μ maximum length. Three apical segments with thicker specialized sensory setae about 38 μ maximum length. Head without a discernible dorsomedial sclerite or a dorsal midcranial ridge. Eyes small, dorsal pair each about 27 μ in diameter, ventral pair each about 30 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, a few with 5; distributed along lateral margins of abdomen, 2 to 4 on each side of segments 3 to 7, 3 to 5 on each side of segment 8, 4 to 8 on each side of segemnt 2; 6 to 8 on each side of prothorax; 6 to 10 or so on anterior part of head between antennae. Tail-forming pore clusters confined to 9th abdominal segment; each cluster consisting of 35 to 40 stellate pores. Body clothed with numerous short digitiform setae about 15 μ maximum length; plus a few slender filamentous setae mostly 15 to 25 μ long. A few longer slender setae, up to about 36 μ maximum length, associated with dermal discs on lateral margins of posterior abdominal segments.

Penial sheath (fig. 3, J) about 117 μ total length; without discernible median lobes; posterior portion tapering to a relatively fine point, about 7 or 8 μ wide at 9 μ before tip.

Legs relatively short, hind femora about 135 to 150 μ long; clothed with short digitiform setae about 15 μ maximum length, plus a few slender filamentous setae about 27 μ maximum length. Claw of hind tarsus about 30 to 32 μ long.

Abdominal sclerotization consisting of a transverse patch on dorsum of 9th segment; a pair of small patches on venter of 9th segment, one on each side near base of penial sheath. Dorsum of segment 8 with a transverse area of weak sclerotization along anterior margin, and an interrupted transverse patch near posterior margin.

Brachypterous male. Similar to macropterous male except for following: wings reduced, non-functional, consisting of pads about 60 μ in length; mesothoracic sclerites smaller. Antennae 8-segmented, about 300 μ or less total length. Eyes

usually smaller than macropterous males, dorsal pair each about 21 μ in diameter, ventral pair each about 24 μ in diameter. Slender filamentous setae of abdomen longer than in macropterous males, up to 30 μ long on anterior segments, about 45 μ maximum length on lateral margins of posterior segments.

Based on 10 specimens (2 macropterous and 8 brachypterous): Honolulu, Oahu, March, 1959 (J. W. Beardsley), reared ex young leaves of MacArthur palm, *Actinophloeus macarthuri* (Wendl.) Becc..

Pseudococcus straussiae Ehrhorn

Pseudococcus straussiae Ehrhorn, 1916. PROC. HAW. ENT. SOC. 3(3):239.

Male. Body length about 1.2 mm.; available specimens macropterous. Antennae 10-segmented, about 690 μ total length; 3rd segment about 90 μ long. Antennae clothed with slender digitiform setae about 36 μ maximum length, plus a few slender filamentous setae about 70 μ maximum length. Three apical segments with thicker specialized sensory setae about 65 μ maximum length. Head with a well-defined midcranial ridge dorsally; without a conspicuously developed dorsomedial sclerite. Eyes moderately large, dorsal pair each about 36 μ in diameter, ventral pair each about 45 μ in diameter.

Dermal discs very few, those discernible with 4 peripheral loculi; most specimens with but 1 or 2 discs on each side of the abdomen, some individuals apparently without discs. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster with about 60 stellate pores. Body sparsely clothed with long slender filamentous setae about 50 μ maximum length. Digitiform setae confined to antennae and legs plus a few, about 30 μ long, on venter of head.

Penial sheath (fig. 3, K) about 135 μ total length; without discernible median lobes; posterior extension tapering to a fine acute point about 6 or 7 μ wide at 9 μ before tip.

Legs moderately long, hind femora about 210 μ total length, clothed with slender filamentous setae about 50 μ maximum length plus a few slender digitiform setae about 33 μ maximum length. Claw of hind tarsus about 45 μ long.

Abdominal sclerotization consisting of a broad transverse patch on dorsum of segment 9; a pair of patches on venter of segment 9, one on each side near base of penial sheath; a pair of small transverse patches near anterior margin of dorsum of segment 8, one on each side of the midline; similar pairs of small transverse patches on anterior margins on dorsum of segments 3 and 4. Setae of posterior abdominal segments with rings or small patches of sclerotization about their bases.

Based on 14 specimens: 8, Mt. Tantalus, Oahu, Feb. 28, 1958 (J. W. Beardsley), reared ex *Straussia* leaves; 6, Waimano Valley, Oahu, Sept. 28, 1958 (J. W. Beardsley), reared ex *Straussia* leaves.

Nesococcus pipturi Ehrhorn

Nesococcus pipturi Ehrhorn, 1916. PROC. HAW. ENT. SOC. 3(3):246.

Male. Body length about 1.1 mm.; available specimens macropterous. Antennae 10-segmented, about 600 μ total length; 3rd segment about 80 μ long. Antennae clothed with slender digitiform setae about 36 μ maximum length, plus a very few slender filamentous setae about 45 μ maximum length. Three apical segments with thicker specialized sensory setae about 50 μ maximum length. Head with a very poorly developed dorsomedial sclerite; with a well-defined midcranial ridge dorsally. Eyes of moderate size, dorsal pair each about 33 μ in diameter, ventral pair each about 36 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; distributed along lateral margins of abdominal segments, 1 to 3 on each side of segments 3 to 8; 5 to 7 on each side of segment 2; 4 or 5 on each side of prothorax; 2 or 3 each side of anterior part of head between antennae. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster consisting of 35 to 45 stellate pores. Body sparsely clothed with fine filamentous setae about 33 μ maximum length; plus a few digitiform setae about 27 μ maximum length distributed on head, venter of thorax, and 2 to 4 per segment on venter of most abdominal segments. Digitiform setae apparently absent on dorsum of abdomen.

Penial sheath (fig. 2, H) about 90 μ total length; without discernible median lobes; posterior portion tapering evenly to a rounded apex, about 10 or 11 μ wade at 9 μ before tip.

Legs of moderate length, hind femora about 190 μ long; clothed with slender digitiform setae about 30 μ maximum length, plus a very few slender filamentous setae of comparable length. Claw of hind tarsus about 42 μ long.

Abdominal sclerotization consisting of a median transverse patch on dorsum of segment 9; a pair of small weak transverse patches on venter of segment 9, one on each side of midline; sometimes a weak narrow transverse median patch near posterior margin of dorsum of segment 8; a pair of small transverse patches on posterior margin of dorsum of segment 2, one on each side of the midline.

Based on 14 specimens: Upper Niu Valley, Oahu, May 2, 1959 (J. W. Beardsley), reared from leaves of *Pipturus*.

Nipaecoccus nipae (Maskell)

Dactylopius nipae Maskell, 1892. TRANS. NEW ZEALAND INSTITUTE 25:232, pl. 15, figs. 12–15.

Pseudococcus nipae (Maskell) Fernald, 1903. CAT. OF THE COCCIDAE OF THE WORLD, p. 107.

Nipaecoccus nipae (Maskell) Ferris, 1950. ATLAS OF SCALE INS. OF NO. AMERICA 5:109, fig. 41.

Male. Small, body length 0.94 mm.; available specimens macropterous. Antennae 10-segmented, about 550 μ long; 3rd segment 60 μ long. Antennal setae mostly long and relatively slender, digitiform type not clearly differentiated although tips of some setae are less filamentous than others; mostly about 30 to 34 μ long. Apical segment with a pair of somewhat thicker specialized sensory hairs. Dorsum of head with a well-defined midcranial suture; without a noticeably developed dorsomedial sclerite. Eyes of moderate size, dorsal pair each about 27 μ in diameter, ventral pair each about 33 μ in diameter.

Dermal discs each about 6 μ outside diameter, with 6 or 7 peripheral loculi; distributed in groups of 6 to 8 on each side of abdominal segments 3 to 8; 10 or 12 on each side of segment 2; 10 or 12 on each anterio-lateral margin of prothorax; 2 discs on anterior part of head between antennae. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster consisting of about 50 to 60 pores of the same type as dermal discs on anterior portions of the body, not stellate. Body sparsely clothed with slender filamentous setae mostly 16 to 20 μ long; digitiform setae absent.

Penial sheath (fig. 2, I) about 84 μ long; median lobes represented by a pair of barely discernible humps; posterior extension short, slender, about 6 μ wide at 9 μ before tip.

Legs moderately small, hind femora about 150 μ long. Setae of legs similar to those of antennae, about 27 μ maximum length. Tarsal claws relatively long, those of hind tarsi about 42 μ in length.

Abdominal sclerotization consisting only of a transverse median patch on dorsum of 9th segment.

Based on a single specimen: Kilauea, Hawaii, Aug. 4, 1946 (E. C. Zimmerman). A second specimen, in poor condition, mounted from material from Waialua, Oahu, March 12, 1938. (O. H. Swezey) on palm, differs in certain minor respects from the Kilauea specimen (e.g.: tarsal claws noticeably smaller, dermal discs much fewer in number). The latter specimen is from material of the yellow form of *N. nipae* (=*N. pseudonipae* of authors; see Ferris, 1948). It is hoped that in the future additional material of both the yellow (*pseudonipae*) and white (*nipae*) forms will become available for study in order to determine if there are consistent morphological differences between males of the two forms.

Nipaecoccus vastator (Maskell)

Dactylopius vastator Maskell, 1895. TRANS. NEW ZEALAND INSTITUTE 27:65, pl. 6, figs. 12–16.
Pseudococcus vastator (Maskell) Kirkaldy, 1902. FAUNA HAWAIIENSIS 3(2):103.
Nipaecoccus vastator (Maskell) Ferris, 1950. ATLAS OF SCALE INS. OF NO. AMERICA 5:103.

Male. Body length about 1.3 mm.; available specimens macropterous. Antennae 10-segmented, 975 to 1,000 μ long; 3rd segment about 100 μ long. Antennae

clothed with many digitiform setae 36 to 40 μ long, interspersed with a few slender filamentous setae of equal length or slightly shorter. Apical segment with 2 or 3 slightly thicker specialized sensory hairs near its tip, these not noticeably longer than digitiform setae. Head with a narrow dorsomedial sclerite. Dorsal and ventral eyes very large, subequal in size, each about 62 μ in diameter.

Dermal discs mostly with 5 or 6 peripheral loculi, an occasional one with 4; distributed in groups of from 2 to 5, one group on each side of abdominal segments 2 to 8, plus a few (usually 2 to 4) distributed across venter of each of most abdominal segments. One or 2 discs behind each spiracle; 2 or 3 at each side of anterolateral portion of prothorax; and usually two on anterior part of head between antennae. Tail-forming pore clusters restricted to ninth abdominal segment; each cluster large, containing around 100 stellate pores. The pair of very long hairs of each cluster set in a crater-like depression lined with closely-packed stellate pores which appear somewhat smaller than other pores in the cluster. Body sparsely clothed with fine slender setae mostly 20 to 30 μ long; a transverse row of 3 or 4 longer setae (up to about 45 μ in length) on the lateral margins of each abdominal segment behind the group of dermal discs. Digitiform setae restricted to antennae.

Penial sheath (fig. 2, J) about 125 μ over-all length; median lobes represented by a pair of very small protuberances; apical extension short, slender, tapering, about 7 μ wide at 9 μ before tip.

Legs moderately large, hind femora about 210 μ long; clothed with slender setae about 36 μ maximum length on hind femora. Tarsal claws long, those of hind legs about 42 μ in length.

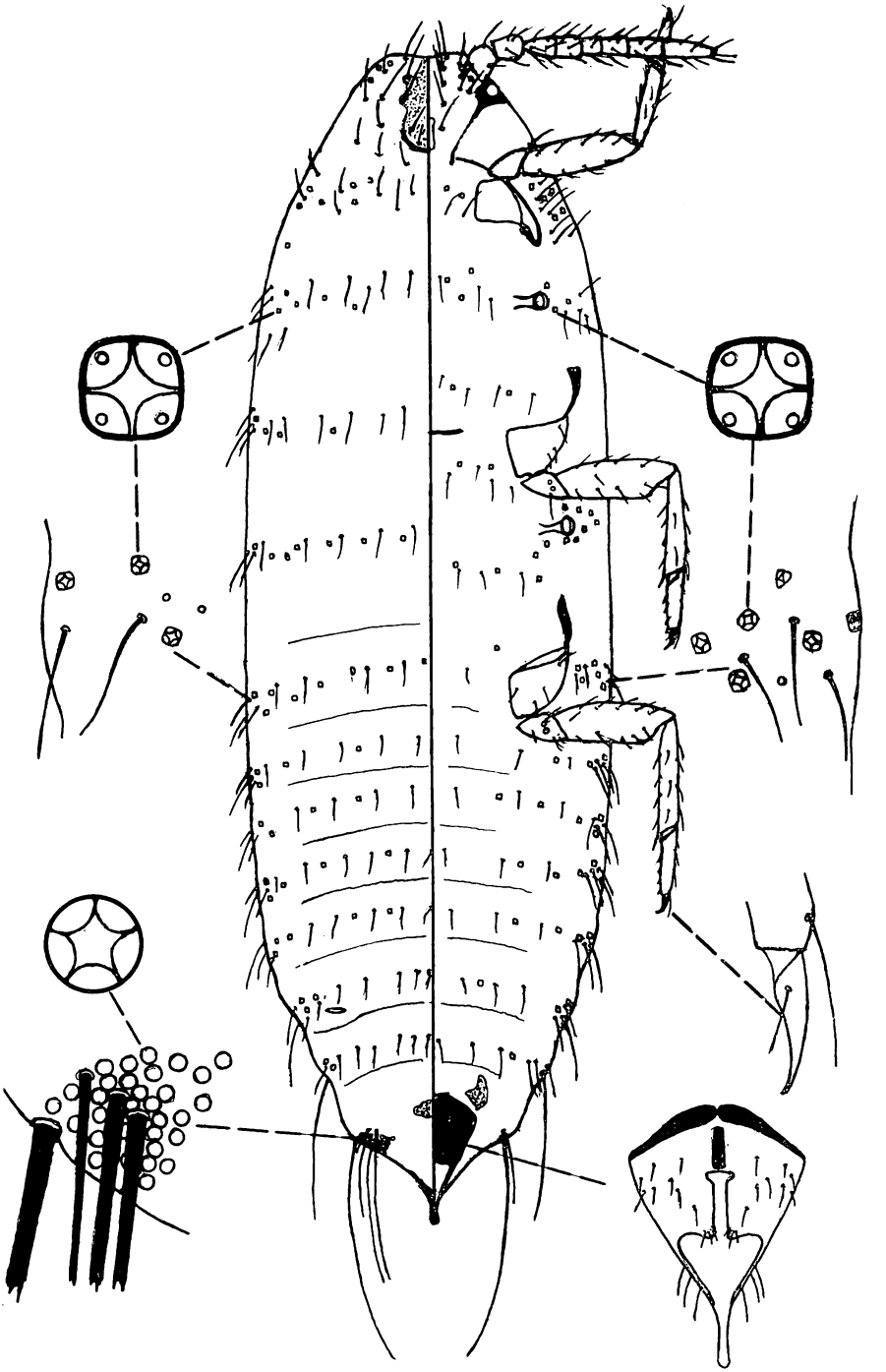
Abdominal sclerotization consisting of a broad transverse patch on dorsum of 9th segment; two patches on venter of 9th segment, one on each side near base of penial sheath; and a pair of small transverse patches on posterior margin of dorsum of segment 2.

Based on 3 specimens: near Koko Head, Oahu, May 19, 1958 (J. W. Beardsley), on *Gossyparium tomentosum* Nutt.

Saccharicoccus sacchari (Cockerell)

Dactylopius sacchari Cockerell, 1895. JOUR. TRINIDAD FIELD NATURALIST'S CLUB 2:195.
Pseudococcus sacchari (Cockerell) Fernald, 1903. CAT. OF COCCIDAE OF THE WORLD, p. 109.
Trionymus sacchari (Cockerell) Fullaway, 1923. PROC. HAW. ENT. SOC. 5:308.
Saccharicoccus sacchari (Cockerell) Ferris, 1950. ATLAS OF SCALE INS. OF NO. AMERICA 5:217, fig. 81.

FIGURE 4. *Saccharicoccus sacchari* (Cockerell), adult apterous male; dorsal and ventral aspects, and details.



Uichanco and Villanueva (1932) described and figured the macropterous male of this species, and Rao (1943) reported the discovery of apterous males and presented a photomicrograph.

Macropterous male. Body length about 1.2 mm. Antennae 9 or 10-segmented (several specimens have one antenna 9- and the other 10-segmented), abour 425 μ total length; 3rd segment about 54 μ long. Antennae clothed with digitiform setae about 27 μ maximum length, plus slender filamentous setae about 34 μ maximum length; Slightly thicker specialized sensory setae on 3 apical segments, about 30 μ maximum length; 1 each on 2 anteapical segments, 1 or 2 on apical segment. Head of normal male pseudococcid type, with a well-defined dorsomedial sclerite. Usual 3 pairs of eyes present, dorsal pair each about 24 μ in diameter, ventral pair each about 27 μ in diameter. Thorax normally developed.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; somewhat less numerous than in apterous males. A group of 1 to 3 discs on lateral margins of each abdominal segment, plus a row, usually of 3 discs, across venter of abdominal segments 5 to 8. Several discs present near each spiracle, across venter of metathorax, and on lateral portions of prothorax; a row of 4 to 6 discs on each side of the anterior part of the head above the bases of the antennae. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster containing about 50 to 60 stellate pores. The usual pair of long tail-forming hairs arising within each pore cluster much longer than those of apterous male, about 330 μ long; long hair at ventral margin of pore cluster of apterous males not developed in macropterous males. Body sparsely clothed with slender filamentous setae about 25 μ maximum length, generally shorter than those of apterous males; group of setae at lateral margins of abdominal segments only slightly longer, about 33 μ maximum length on 8th segment, much less noticeably developed than in apterous males. Digitiform setae confined to antennae and legs.

Penial sheath (fig. 3, L) about 135 μ total length; the median slit opening abruptly about half the distance from base to apex, its margins forming approximately right angles at this point; median lobes represented by small protuberances at the angles so formed. Posterior extension of sheath moderately elongate, slender, the apex slightly expanded and rounded, about 6 or 7 μ wide at 9 μ before tip.

Legs moderately short, hind femora about 155 to 160 μ long; clothed with digitiform setae about 27 μ maximum length, plus a few slender filamentous setae about 24 μ maximum length. Claw of hind tarsus about 33 μ long.

Abdominal sclerotization consisting of a median transverse patch on dorsum of segment 9; a pair of smaller patches, one on each side of the midline, on venter of segment 9; a pair of weak median transverse patches on dorsum of segment 8, one along posterior margin and one along anterior margin; a pair of weak transverse patches, one on each side of the midline of the dorsum, on the posterior margins of segments 2, 3, and 4.

Apterous male. (fig. 4) Body length about 1.25 mm. Antennae 8-segmented, about 225 μ total length; 3rd segment about 36 μ long. Antennae clothed with a few digitiform setae about 18 μ maximum length, plus filamentous setae about 34 μ maximum length. Slightly thicker specialized sensory hairs, about 30 μ maximum length, present on 2 apical segments, usually 1 on 7th segment and 2 or 3 on 8th segment. Head largely unsclerotized except for a pair of narrow arcuate sclerites dorsally near the posterior margin; sometimes an irregularly shaped area of weak sclerotization ventrally between antennae, and a similar weak area dorsally in front of the arcuate sclerites. Dorsal and ventral eyes absent; lateral ocelli present, each surrounded by sclerotized margins; a vestige of the postocular ridge extending ventrad from each eye. Thorax unsclerotized except for a vestigial pleurite at articulation of each coxa.

Dermal discs mostly with 4 peripheral loculi, as in macropterous males; fairly numerous on lateral margins of the thorax, particularly near the spiracles, and on lateral margins of anterior abdominal segments; posterior abdominal segments mostly with 2 to 4 discs on each side. A transverse row of 2 to 6 discs across the venter of each abdominal segment anterior to the 9th, the discs absent from the midventral region of the segment. Dorsum of each abdominal segment with 1 to 3 discs in a transverse row on each side, absent in the mediodorsal area. Tail-forming pore clusters limited to pair on 9th abdominal segment; each cluster containing about 30 stellate pores. The usual pair of tail-forming setae which arise within each pore cluster relatively short, each about 150 μ long; a much thicker, longer hair, about 250 μ in length, arising on the ventral margin of each pore cluster. Body fairly sparsely clothed with slender filamentous setae about 30 μ maximum length on dorsum; a row of 4 to 6 longer setae present on lateral margins of each abdominal segment, these about 60 μ maximum length on anterior segments, much longer on segments 7 and 8, about 150 μ maximum length on segment 8. Digitiform setae apparently confined to antennae and legs.

Penial sheath not differing noticeably from that of macropterous male.

Legs small, hind femora about 135 to 140 μ long; clothed with slender filamentous setae about 30 μ maximum length, plus a very few digitiform setae about 20 μ maximum length. Claw of hind tarsus about 30 μ long.

Abdominal sclerotization consisting of an irregular transverse area on dorsum of 9th segment; a pair of small patches on venter of 9th segment, one on each side of the midline.

Based on 20 specimens, 9 macropterous and 11 apterous; from various localities on Oahu, 1956 to 1959, (J. W. Beardsley), reared ex sugar cane.

Trionymus lounsburyi Brain

Trionymus lounsbury Brain, 1912. ANN. ENT. SOC. AMERICA 5(2):179, figs. 2, 3.

The original treatment includes a brief description and crude figure of the male.

Male. Body length about 1.1 mm.; available specimens macropterous. Antennae 10-segmented, about 580 μ total length; 3rd segment about 80 μ long.

Antennae clothed with short digitiform setae 15 to 18 μ long, plus slender filamentous setae about 45 μ maximum length. Slightly thicker specialized sensory hairs of 3 apical segments about 30 μ maximum length. Head with well-defined midcranial ridge dorsally; dorsomedial sclerite poorly developed; the usual ventral leg of the midcranial ridge anterior to the ventral eyes broadened to form a triangular sclerotized area extending to the base of the lateral branches of the midcranial ridge. Eyes small, dorsal pair each about 22 μ in diameter, ventral pair each about 24 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; 1 to 3 on each side of most of abdominal segments 3 to 8; 3 to 6 on each side of segment 2; 5 or 6 on each side of prothorax; 4 or so on anterior part of head between antennae. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster consisting of about 40 stellate pores. Body sparsely clothed with slender filamentous setae mostly 12 to 18 μ long. Digitiform setae apparently confined to antennae.

Penial sheath (fig. 3, M) about 100 μ in length; with a pair of small but readily discernible median lobes; posterior portion tapering to a rounded apex, about 8 μ wide at 9 μ before tip.

Legs moderately small, hind femora about 150 μ long; clothed with slender filamentous setae about 24 μ maximum length, without digitiform setae. Claw of hind tarsus about 27 μ long.

Abdominal sclerotization poorly developed, consisting of a weak median transverse patch on dorsum of 9th segment, and a pair of small weak patches on venter of 9th segment, one on each side of the midline.

Based on 2 specimens: Mokuleia, Oahu, March 1959 (O. Degener), on *Crinum* lily.

Trionymus multiductus Beardsley

Trionymus multiductus Beardsley, 1959. PROC. HAW. ENT. SOC. 17(1):52, fig.5.

Male. Body length about 1.3 mm.; available specimens macropterous. Antennae 10-segmented, about 700 μ total length; 3rd segment about 84 μ long. Antennae clothed with digitiform setae about 27 μ maximum length, plus slender filamentous setae about 60 μ maximum length. Thicker specialized sensory hairs of 3 apical segments about 60 μ maximum length. Head with a broad well-developed dorsomedial sclerite. Eyes of moderate size, dorsal pair each about 30 μ in diameter, ventral pair each about 34 μ in diameter.

Dermal discs with 4 peripheral loculi; 1 or 3 on each side of abdominal segments 3 to 8; 4 to 6 on each side of segment 2; a few on each side of prothorax; apparently absent on head. Tail-forming pore clusters restricted to pair on 9th abdominal segment; each cluster consisting of about 60 to 70 stellate pores. Body sparsely clothed with slender filamentous setae about 30 μ maximum length; digitiform setae confined to antennae and legs.

Penial sheath (fig. 3, N) about 150 μ in length; without discernible median lobes; posterior portion relatively slender with rounded apex, about 10 μ wide at 9 μ before tip.

Legs moderately large, hind femora about 210 μ long; clothed with digitiform setae about 27 μ maximum length, plus slender filamentous setae about 36 μ maximum length. Claw of hind tarsus about 40 μ long.

Abdominal sclerotization consisting of a large, well-defined, median transverse patch on dorsum of segment 9: a pair of fairly large patches on venter of 9th segment, one on each side of midline; several small transverse patches on dorsum of segment 8 (apparently representing two interrupted transverse patches); a pair of small transverse patches, one on each side of midline, near the anterior margin on segments 3 and 4. Abdominal setae, particularly those of posterior segments, with prominent rings of sclerotization around their bases.

Based on 2 specimens: North Halawa Ridge, Oahu, March 15, 1958 (J. W. Beardsley), in folded-over leaves of *Syzygium sandwicensis* (Gray) Niedenzu.

Trionymus refertus Ferris

Trionymus refertus Ferris, 1948. INS. HAWAII 5:261, fig. 141.

Male. Body length about 1.1 mm.; available specimens macropterous. Antennae 10-segmented, moderately short, about 480 μ in total length; 3rd segment about 50 μ long. Antennae clothed with slender digitiform setae about 26 μ maximum length, plus slender filamentous setae 45 μ maximum length. Thicker specialized sensory hairs of 3 apical segments about 45 μ maximum length. Head with a moderately well-developed dorsomedial sclerite. Eyes moderately small, dorsal pair each about 27 μ in diameter, ventral pair each about 30 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, an occasional one with 3 or 5; 1 or 2 on each side of most of abdominal segments 2 to 8, occasionally absent on 1 or both sides of 1 or 2 segments; a few, usually 4 to 6, on each side of prothorax, apparently absent on head. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster consisting of about 50 stellate pores. Body sparsely clothed with slender filamentous setae mostly 21 to 30 μ long. Digitiform setae confined to antennae and legs, plus a few on the head, mostly on the ventral portion, about 20 μ maximum length.

Penial sheath (fig. 3, O) about 110 μ in length; without discernible median lobes; posterior portion tapering to a moderately slender, nearly truncate apex, about 9 μ wide at 9 μ before tip.

Legs fairly small, hind femora about 135 μ long; clothed with digitiform setae about 35 μ maximum length, plus slender filamentous setae about 30 μ maximum length. Claw of hind tarsus about 27 μ long.

Abdominal sclerotization consisting of a fairly large median transverse patch on dorsum of segment 9; a pair of small patches on venter of 9th segment, one on each side of the midline; a pair of small, weak, narrow transverse patches on

anterior margin of dorsum of segment 8, one on each side of the midline; and an interrupted median transverse patch near posterior margin of dorsum of segment 8. Most of abdominal setae with narrow weak rings of sclerotization around their bases.

Based on 2 specimens: Wiliwilinui Ridge, Oahu, May 30, 1958 (J.W. Beardsley), ex rolled edges of leaves of *Syzygium sandwicensis* (Gray) Niedenzu.

Trionymus rostellum Lobdell

Trionymus rostellum Lobdell, 1930. ANN. ENT. SOC. AMERICA 23:219, pl. XI.

Male. Body length about 0.8 mm.; available specimens macropterous. Antennae 10-segmented, rather short, about 430 μ total length; 3rd segment about 45 μ long. Antennae clothed with very short digitiform setae about 10 μ maximum length, plus a few slender filamentous setae about 40 μ maximum length. Specialized sensory setae of 3 apical segments not appreciably thicker than digitiform setae, about 36 μ maximum length. Head with a broad, well-developed mediodorsal sclerite. Eyes small, dorsal pair each about 20 μ in diameter, ventral pair each about 23 μ in diameter.

Dermal discs mostly with 4 peripheral loculi, some with 5; 1 or 2 present on each side on each of abdominal segments 2 to 8; a few on each side of prothorax; 1 to 3 on each side of head between antennae. Tail-forming pore clusters confined to pair on 9th abdominal segment; each cluster consisting of about 35 to 40 stellate pores. Body sparsely clothed with slender filamentous setae about 18 μ maximum length; digitiform setae apparently confined to antennae and legs.

Penial sheath (fig. 3, P) about 80 μ total length; with a pair of small but readily discernible median lobes; posterior portion forming a relatively short, fine, apically rounded projection, about 6 μ wide at 9 μ before tip.

Legs small, hind femora about 115 μ long; clothed with filamentous setae about 21 μ maximum length on hind tibiae, plus a few digitiform setae about 18 μ maximum length. Claw of hind tarsus about 22 μ long.

Abdominal sclerotization consisting of a median transverse patch on dorsum of segment 9; and a pair of small patches, one on each side of the midline, on venter of segment 9.

Based on 4 specimens; Aina Haina, Honolulu, Hawaii, March, 1955 (J. W. Beardsley), reared ex grass.

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